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Friend or foe?

Exploring the role of the ecosystem services concept in environmental governance

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ABSTRACT

The ecosystem services (ES) concept has emerged as a major theme in environmental research and governance in recent decades (Chaudhary et al., 2015; Costanza et al., 2017). Proponents of the concept highlight its potential to alert policy makers, businesses, and citizens to our dependence on the natural world. Yet since its inception the concept has been plagued with criticisms of putting market prices on, and ultimately commodifying, nature. This thesis aims to explore debates and tensions within the ES concept through a series of conceptual discussions and empirical investigations. What is revealed is that ES is neither a silver bullet, nor a grave threat. It is a deeply ambiguous concept that takes multiple forms in the different contexts in which it is applied. Through a case study in Scottish inshore governance I show how the concept is shaped by existing institutions, norms, and policy priorities. Rather than dismissing the concept then, what is important is guiding its deployment to ensure it reflects the complex ways in which humans live in, with, and from the non-human world. To this end, I identify guiding principles for the ES concept including inter-and transdisciplinary working and of the consideration of pluralistic environmental values. With these principles in mind, the rest of the thesis is given over to methodological considerations. I first make the case for a post-normal science framing in ES research. This post-normal approach is then demonstrated through the application of a Deliberative Democratic Monetary Valuation in the context of marine planning. This thesis is therefore both descriptive and prescriptive, and ultimately intends to help guide the operationalisation of the ES concept.

LAY SUMMARY

Humans gain many benefits from nature. These include the food we harvest, the regulation of our climate, and the peace and respite we get from a walk in the woods. It has become increasingly common to talk about such benefits as 'ecosystem services', and researchers and policy makers are seeking to identify, measure and value these services to enable us to make better decisions about how we manage the environment. Whilst understanding the many ways nature benefits humans may be useful, the ecosystem services concept is not without its critics.

Some view the ecosystem services concept as too human-centric; they are worried that if we only care about how nature benefits us we will no longer seek to protect nature for its own sake. Others are worried that attempting to value ecosystem services is the same as 'putting a price on nature', and that this price can never reflect natures true value.

This thesis is about this debate. It is about the different ways that the ecosystem services concept is understood and adopted. It starts by exploring how policy makers and researchers see the concept, and how they believe it should be used. What is seen to be important is ensuring the concept is used in a way that helps create more sustainable societies, is not tunnel-visioned, and reflects the many different ways that people understand and value the natural world. But we cannot be sure that this is what will happen in practice.

Through looking at how the concept is used in marine management in Scotland, I show that there are many forces shaping the process of adoption – and the outcome is not certain. Many areas of policy, such as conservation and regulation of economic activities, already have established ways of doing things and are unlikely to integrated new considerations of ecosystem services. Where the concept is used more is as a planning tool to help understand who will lose out and who will benefit from changes to planning rules.

The way the ecosystem service concept is used is also shaped by the norms that exist about how policy is made in a given place. In Scotland, devolved and inclusive forms of decision making are increasingly the norm, and this is reflected in how the ecosystem services concept is being used. However, there is still relatively little effort to ensure the full range of environmental knowledge and values are

considered when evaluating ecosystem services. The rest of the thesis seeks to develop new tools and methods for assessing and valuing ecosystem services that address this gap. Ultimately the thesis aims to provide a resource for policy makers and researchers to assist them in understanding the ES concept and its potential pitfalls, to ensure that they do not misuse the concept.

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DECLARATION OF OWN WORK

This thesis has been written by me, Jacob Ainscough, and is my own original work, except where indicated throughout the thesis and summarised below. No part of this thesis has been submitted for any other degree or professional qualification.

Signed:

Jacob Ainscough, 16/03/2021

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		A. D	33%
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Note on case study in Box 1.

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I was involved in developing the concept and methodology of the paper, in conducting one element of data collection and analysis, and in providing comments and edits on the manuscript. The majority of the writing was done by the two lead authors Andrew Kadykalo and Maria Lopes-Rodriguez.

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CONTENTS

GLOSSARY OF ACRONYMS

CMPP - Clyde Marine Planning Partnership

DDMV - Democratic deliberative monetary valuation

DMV - Deliberative monetary valuation

EESC - European Ecosystem Services Conference

EIA - Environmental Impact Assessment

ES - Ecosystem service(s)

ICES - International Council for the Exploration of the Sea

IPBES - Intergovernmental Platform for Biodiversity and Ecosystem Services

LDP - Local Development Plan

MEA - Millennium Ecosystem Assessment

MPA - Marine Protected Area

MSC - Marine Stewardship Council

NCP - Nature's Contributions to People

NGO - Non-governmental organisation

NMP - Scottish National Marine Plan

PES - Payments for Ecosystem Services

SA - Sustainability Appraisal

SEA - Strategic Environmental Assessment

SEPA - Scottish Environmental Protection Agency

SNH - Scottish Natural Heritage

UK NEA - UK National Ecosystem Assessment

1 INTRODUCTION

The ecosystem services (ES) concept has emerged as a major theme in environmental research and governance in recent decades (Chaudhary et al., 2015; Costanza et al., 2017). ES are defined in the 2005 landmark Millennium Ecosystem Assessment (MEA) as, “the benefits provided by ecosystems to humans, which contribute to making human life both possible and worth living” (Millennium Ecosystem Assessment, 2005 p. 23). The central idea behind the concept is straight forward – identifying and valuing the many benefits humans gain from functioning ecosystems should lead to more sustainable decision making that prioritises human welfare. These decisions should de facto be more equitable, as the interests of groups that are obscured by a narrow economic calculus are brought into focus. ES are often separated into ‘provisioning’ services, such as food and building materials, ‘regulating’ services such as a stable climate and ‘cultural’ services such as beautiful landscapes and recreational activities (Albon et al., 2014; Costanza et al., 2017; Millennium Ecosystem Assessment, 2005). ‘Supporting’ services are included in some categorisations, referring to natural processes that underpin other services, but are not directly beneficial to humans.

The ES concept is an attempt to redress the balance in a world where narrow economic considerations are often prioritised. The need for this has never been more urgent. At present no country sustainably provides for the needs of their citizens (O’Neill et al., 2018). We have less than a decade to fundamentally reshape economic activity to avoid catastrophic levels of climate change and biodiversity loss (Díaz et al., 2019; IPCC, 2018). On average, populations of vertebrate species have declined by 60% since 1970 (WWF, 2018), and we are currently overexploiting above a quarter of the worlds fish stocks (FAO, 2020). At the same time, Gross Domestic Product (GDP) growth has been sustained globally at an average rate of approximately 3% per year. This growth is providing diminishing wellbeing returns in much of the developed world and hides growing inequalities in wealth and incomes (Kallis, 2017). The recent Covid-19 pandemic has brought entrenched inequalities at the inter- and intrastate scale to the fore.

At a global level, metrics of resource exploitation and environmental degradation track GDP growth with remarkable tenacity (Hickel and Kallis, 2019; Wiedmann et al., 2015). Continued growth of economic activity is clearly no longer sustainable in

its current form. The Limits to Growth report of 1972 has perhaps unsurprisingly come back into vogue. Periodic reassessments of empirical data suggest the world is on track for the 'Standard run' form of the Limits to Growth model, indicating societal collapse by mid-century (Meadows et al., 1972; Turner, 2014, 2012, 2008).

This is the context in which the ES concept emerged. It can be seen as a conceptual apparatus for squaring the circle between the pursuit of economic objectives, and the environmental destruction this wreaks. To its supporters, it is an attempt to codify the adage that, 'you cannot eat money'. Yet to its detractors it is anything but (McCauley, 2006; Silvertown, 2015). To them, the ES concept and related natural capital concept are a trojan horse for the commodification of nature and the creep of market institutions into ever increasing parts of our lives (Gómez-Baggethun et al., 2010; McCauley, 2006; Silvertown, 2015; Victor, 2020). Viewed this way, the ES concept is an outgrowth of the economic logic behind the very system undermining the ecological basis for life on earth. The idea that it could contribute to a more sustainable future is seen as perverse.

Debates on the relative merits of the ES concept are complicated by a lack of shared understanding regarding what the concept entails. The ES concept occupies an uncomfortable space between academic disciplines and attempts to transect several epistemological and ethical positions. An ever-growing plethora of ES conceptual models and categorisation systems exist, and the emergence of a common global framework appears unlikely.

Understanding if the ES concept is a danger or an opportunity for environmental governance is not a purely conceptual question. At least as significant is how it is adopted in practice. Even whilst theoretical debates continue, calls have grown for the ES concept to make good on its promise of delivering more sustainable decisions (Billé et al., 2012; Daily et al., 2009). A growing body of literature investigates whether, and if so how, the ES concept is being used policy and decision making (Bezák et al., 2017; Bouwma et al., 2018; Carmen et al., 2018; Goméz-Baggethun and Perez, 2011; Jax et al., 2018; Matzdorf and Meyer, 2014; Mauerhofer and Laza, 2018a; Mckenzie et al., 2014; McKinley et al., 2018; Posner et al., 2016; Rounsevell et al., 2019; Rozas-Vásquez et al., 2018; Ruckelshaus et al., 2013; Turnpenny et al., 2014). Understanding how the ES concept is used in practice is not simple. The multitude of existing interpretations of the concept mean it is not easy to pin down exactly what 'it' is. The picture is muddied further by the

inherently complex and messy nature of integrated environmental and economic policy and decision making, and the variety of institutional contexts in which one may seek to operationalise an ES framing.

The intention of this thesis is to traverse this messy terrain to attempt to inform the operationalisation of the ES concept. Ultimately I aim to understand if the ES concept is the thin end of the commodification wedge, or represents an opportunity to improve environmental governance. I came through my university education at a time when the ES concept was starting to take hold, and remember being told in an early conservation science lecture on environmental valuation, 'if you want a job in the future, this is the area to get involved in'. Like many who are confronted with the ES concept for the first time, I developed a series of questions about it. This thesis is, in part, my attempt to answer some of these. In trying to make sense of the concept I have approached it from various perspectives and my methodology and research approach are necessarily experimental and non-linear in exploration. The thesis includes both conceptual contributions as well as empirical work.

The thesis begins, with this introductory chapter, by mapping out the terrain of academic debate surrounding the ES concept. This is necessary as the remainder of the thesis draws from several academic disciplines and seeks to make interventions in some of the key ongoing debates in ES. Though my background training as a zoologist allows me to appreciate and understand the ecological dimension of ES, my primary interest is in studying ES as a contested social construct. I believe it is only by understanding how the ES concept shapes and is shaped by social forces that we can understand its potential. My aim in this thesis is to bring some of the insights of social science to bear on the ES concept, to understand its possibilities and dangers, and to guide its operationalisation.

To provide context, Section 1.1 contains a brief history of the emergence of the ES concept. Section 1.2 and 1.3 cover major ES conceptual frameworks and categorisation systems that have been developed, using these to discuss how understanding of the concept has shifted over time and remains contested. Section 1.4 then presents the key tenets of the case for and against the ES concept. From here I present my research objective, questions and present an overview of the focus and methods of each chapter. The Chapter then concludes with a summary of the main findings and contributions of the thesis in Section 1.10.

In Chapter 2, I present the ontological and epistemological position adopted in the thesis. I also comment on the origins of the thesis as a way to discuss my own positionality as a researcher. The main body of the thesis then consists of four chapters, each exploring the ES concept from a different perceptive and building on insights from previous chapters. The first two chapters focus on how the ES concept is understood and used by different user groups, and the process by which it is institutionalised. In Chapter 3, I present the results of a mixed methods survey into the views of the ES concept from policy makers, academics and practitioners. From these results I identify key principles to guide the use of the ES concept and develop a framework for understanding the institutionalisation of the ES concept. This framework is then developed further in Chapter 4 through an in-depth case study of the use of the ES concept in inshore marine governance in Scotland. Chapters 5 and 6 are more methodological, seeking to guide the application of ES in a way that builds on its strengths and avoids potential pitfalls. Chapter 5 develops an argument for the adoption of post-normal science as a framing for ES research. Finally, Chapter 6 picks up on themes from Chapters 3, 4 and 5 and presents a methodology for integrating shared and plural values into ES valuation in a public policy setting.

1.1 THE HISTORY OF THE CONCEPT

In this section I review the history of the ES concept, drawing from existing histories in the literature (Chaudhary et al., 2015; Gómez-Baggethun et al., 2010; McDonough et al., 2017; Mooney and Ehrlich, 1997). It is worth noting from the start that the ES concept emerged from a distinctly Western line of thought. Studies of research trends also show that Western countries account for the vast majority of ES research output (Chen et al., 2020; Zhang et al., 2019). This has implications for attempts to adopt ES as a 'universal' framework in venues like the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES).

1.1.1 Before the 'big bang'

The idea that humans 'depend' on nature has likely existed in some form for at least as long as the 'human'/'nature' dualism in Western thought (Castree, 2014). It is not, therefore, clear where the story of ES should start. Histories of ES like those of Mooney and Ehrlich (1997) and Chaudhary et al. (2015) typically begin with the growing awareness of environmental damage from human activity in the late 19th

and early 20th century. They trace a line through the classics of the conservation genre from George Marsh's 'Man and Nature' (1867), through Aldo Leopold's 'The Land Ethic' (1949), to books such as Rachel Carson's 'Silent Spring' (1962). The first use of the 'services' frame seems to have been the 1970 Study of Critical Environmental Problems (SCEP) which makes refence to 'environmental services' that would decline if there were a decline in ecosystem function (Chaudhary et al., 2015). This language then reappears in Westman's (1977) *Science* article 'How much are nature's services worth?'. Then, the widely accepted first appearance of 'ecosystem services' comes from Ehrlich and Ehrlich's (1981), 'Extinction: the causes and consequences of the disappearance of species'.

ES is, therefore, a concept that emerged primarily from the nature conservation community. The statement from the SCEP report cuts to the heart of the founding logic of the ES concept – it effectively says, 'here is a list of the reasons that we should want healthy, functioning ecosystems'. Whether this is necessarily an exclusively utilitarian framing is widely debated (Potschin et al., 2016; Silvertown, 2015; Wilson and Law, 2016). What is clear is that the concept emerged from a community of scholars and activists increasingly concerned with environmental degradation, who saw highlighting the benefits of functioning ecosystems to humans as a route to their protection.

1.1.2 Mainstreaming

In 1997, 20 years after Westman (1977) posed the question 'how much are natures services worth', Costanza et al. (1997) took the first shot at answering him in their landmark *Nature* paper, 'The value of the worlds ecosystem services and natural capital'. In the same year, Gretchen Daily's, 'Nature's Services: Societal dependence on natural systems' was published, bringing together contributions from many early pioneers of the ES concept (Daily, 1997). These were certainly landmark publications, but the real 'big-bang' occurred only after the MEA was published in 2005 (Millennium Ecosystem Assessment, 2005). This review of global ES, led by the United Nations, catapulted the concept into the mainstream, precipitating an explosion in research interest (Figure 1).

Since this time, other major landmarks include The Economics of Ecosystems and Biodiversity project (TEEB, 2010) and the establishment of the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES), first agreed in 2010 and

established formally in 2012. By this point, in the words of Chaudhary et al. (2015, p 31), the ES concept had, “arrived as a globally significant force”.

A relatively rapid process of institutionalisation occurred at the international level following the explosion of academic interest in ES. The launch of the MEA drove many large environmental Non-Governmental Organisations (NGOs) to adopt the concept, often in the form of support for Payment for Ecosystem Service (PES) schemes (Chaudhary et al., 2015; Fisher and Brown, 2015). The strategic plan for the Convention on Biological Diversity (CBD) from 2011 to 2020 explicitly integrated considerations of ES.

As can be seen in Figure 1, ES research output has continued to grow. Most of this work still comes from the concept’s founding environmental science related disciplines (Figure 1, (a)). The ES concept is often said to have emerged out of dialogue between ecologists and economists (Chaudhary et al., 2015; Díaz et al., 2015a; McDonough et al., 2017). Yet economic studies make up a much smaller proportion of ES research and have not kept pace with overall growth in research interest (Figure 1, (b)). This matches findings from McDonough et al. (2017), who find environmental science accounting for the vast majority of ES publications they analysed. Similar trends exist in more recent studies of ES literature (Chen et al., 2020; Zhang et al., 2019), although McDonough et al. (2017) did demonstrate a widening of disciplinary engagement with the concept over time.

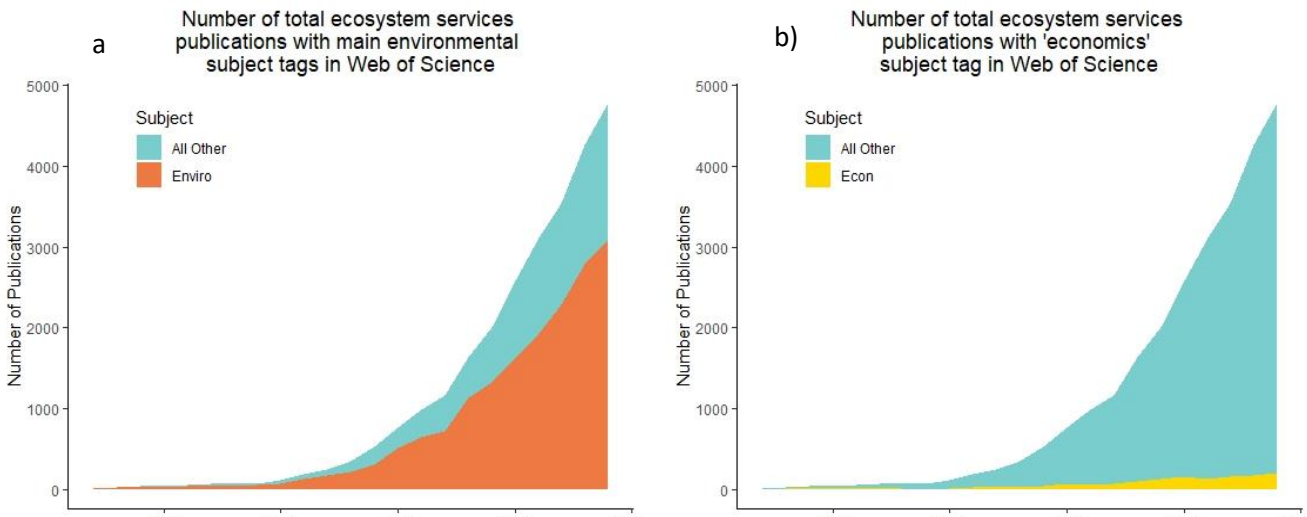

Figure 1. Graphs showing total number of publications with a topic of ‘ecosystem services’ from Web of Science and (a) publications with at least one of the subject tags ‘Ecology’, Environmental Science’, ‘Environmental Studies’ or ‘Biodiversity Conservation’ in red, and (b) publications with the subject tag ‘Economics’ in yellow

To show how the concept has evolved, in Sections 1.2 and 1.3 I review conceptual models and classification systems for ES. I do not attempt to give a comprehensive account of all existing ES conceptual models. I have selected a sample of models to demonstrate key conceptual differences. Then, in Section 1.4 I discuss additional debates regarding the ES concept before outlining my research objective and questions.

1.2 CONCEPTUAL MODELS

As stated above, the original purpose of the ES concept was to demonstrate the societal benefits of functioning ecosystems. Many conceptual models have been developed to represent this link between ecosystem functioning and societal wellbeing. These models have become increasingly complex through integration of more elements of the complex socio-ecological systems from which ES emerge. Below I introduce some of the key models and discuss the innovations and debates that have accompanied them.

The first two models I discuss are the classic 'cascade' model presented by Haines-Young and Potschin (2010) (Figure 2) and the first conceptual framework of the UK National Ecosystem Assessment (NEA), one of the most comprehensive and ambitious national follow-ons from the MEA (Watson et al., 2011) (Figure 3).

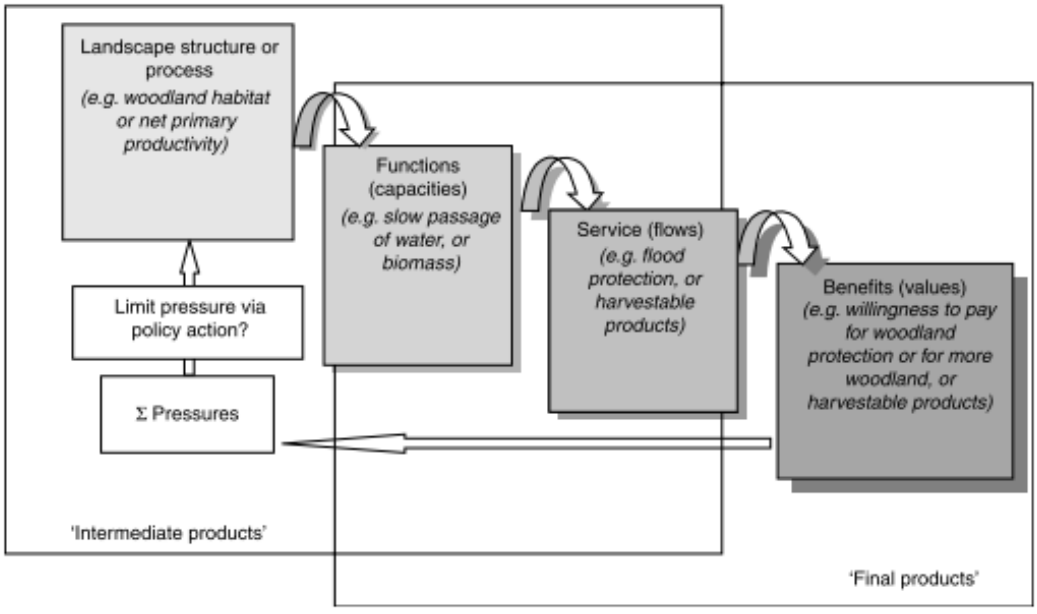

Figure 2. Cascade model of ecosystem service provision, reproduced from Haines-Young and Potschin (2010)

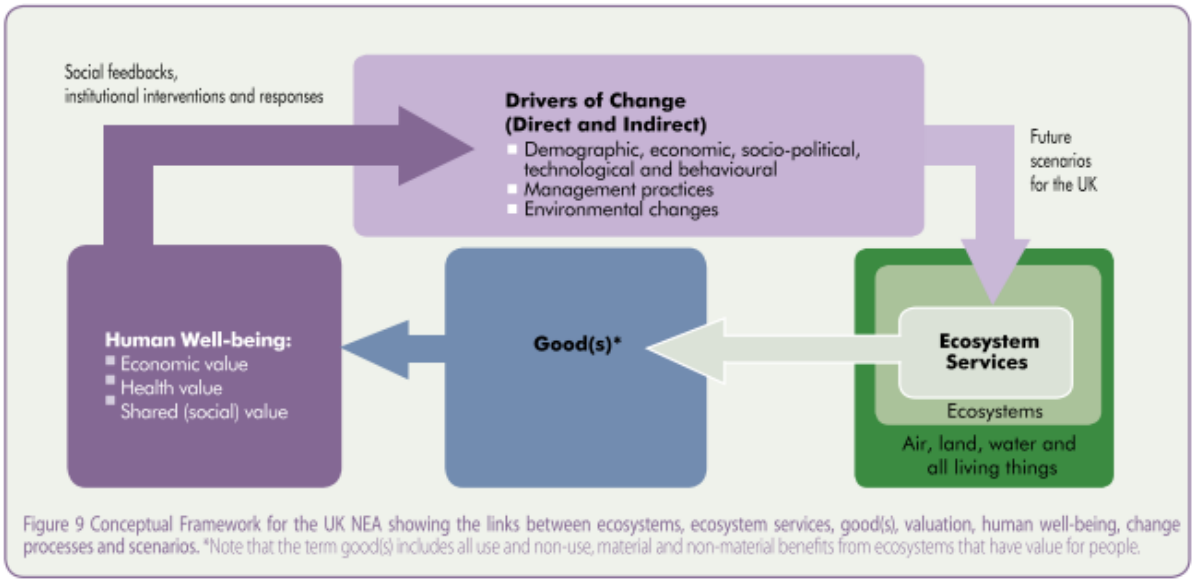

Figure 3. Conceptual model of ecosystem service provision reproduced from the UK National Ecosystem Assessment (2010)

These early models represent a simple flow from functioning ecosystems, through to goods and services that contribute to human wellbeing. Relationships are unidirectional and each stage of the production 'chain' is boxed off with minimal disaggregation. The only feedback mechanism represented is information about human wellbeing impacting on the drivers of environmental change. The Haines-Young and Potschin model separates 'intermediate' products from 'final' products (those that are directly consumed by humans). This intermediate/ final distinction exists across various models and categorisation systems.

The next major conceptual innovation was to consider how different forms of capital make up ES, and how institutions mediate the flow of services directly, as well as impacting on environmental pressures (Albon et al., 2014; Jones et al., 2016) (Figure 4 and Figure 5). The concept of 'natural capital' emerged alongside the ES concept and refers to the 'stock' of a natural resources from which ES flow. This representation of complex ecological systems as 'stocks' has caused much debate within the ES community (Norgaard, 2010; Propper and Haupts, 2014; Schröter et al., 2014). Yet, representing nature in this way allows it to be stacked alongside other forms of 'human capital', emphasising that most ES require a combination of human and non-human inputs. For example, a fish stock will not provide the service

of food unless combined with a boat and fishing equipment (built capital) and a willing fisher with the knowledge of how and where to fish (human capital), at a minimum.

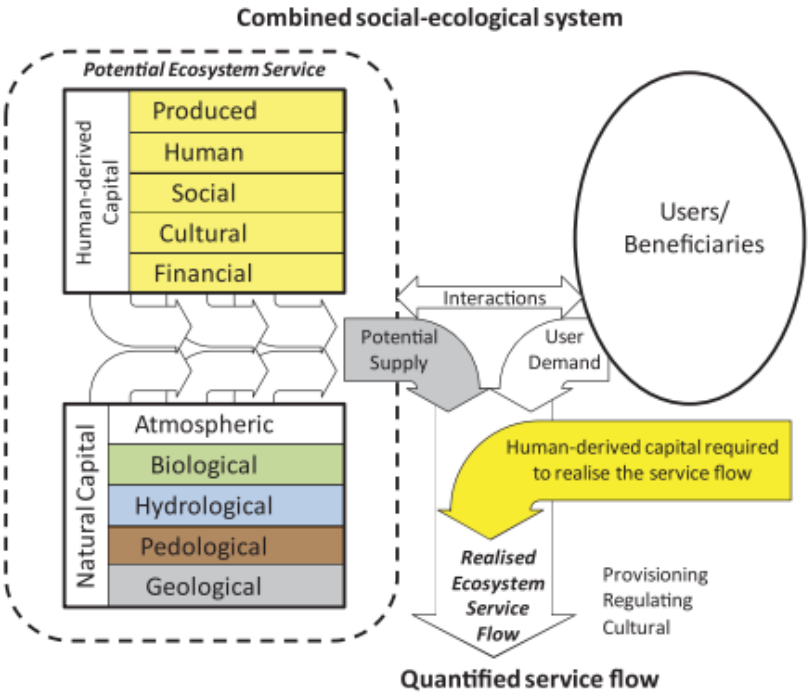

Figure 4. Conceptual model of ecosystem service provision reproduced from Jones et al. (2016)

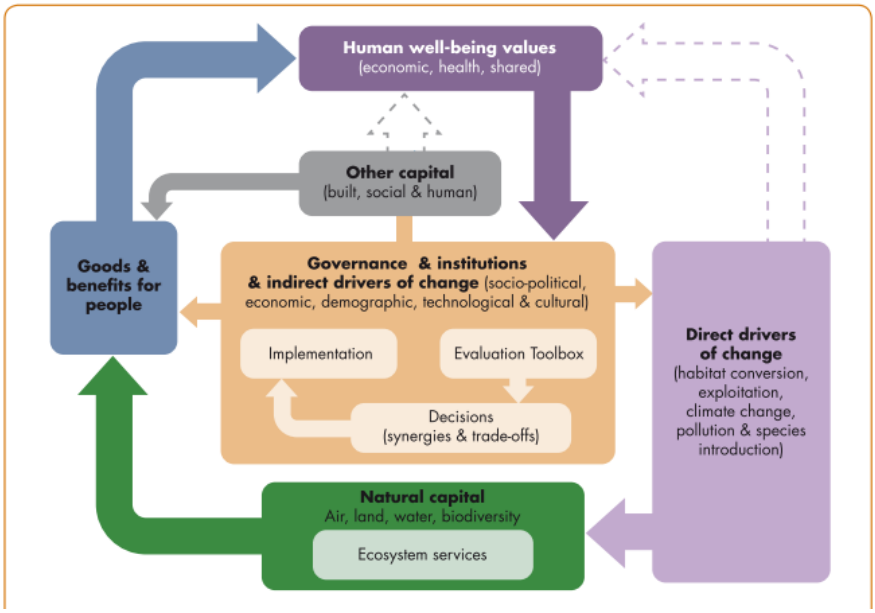

Figure 5. Conceptual model of ecosystem service provision reproduced from UK National Ecosystem Assessment Follow-On (Albon et al. 2014)

The advantage of this disaggregation of capital types is its contribution to the long-running 'soft' vs 'hard' sustainability debate (Gómez-Baggethun et al., 2010; O'Neill et al., 2008). The soft sustainability position holds that a high level of substitutability exists between different forms of capital. There is therefore no inherent reason to believe that if one form of capital were to be depleted (e.g. a fish stock), it could not be replaced by another. The hard sustainability argument is that there is a low level of substitutability between capital types for many goods and services, and thus each capital input needs to be used at a sustainable rate. The models presented above certainly help to add clarity to this debate by conceptually delineating the different types of capital required for the production of a particular ES. Of the two, it is the framework of Jones et al. (2016) that most explicitly disaggregates capital types. This model is less explicit about the role of institutions in mediating the flow of services, representing them only as "human-derived capital required to release the service flow". This model also does not attempt to integrate feedback loops.

The conceptual model developed by Albon et al. (2014), for a UK NEA follow-on project (NEAFO) represents only 'natural capital' and 'other capital', however has a more explicit role for institutions as both impacting on environmental pressures and directly intermediating the delivery of ES. This model is also more holistic in that it attempts to represent feedback loops between different parts of the system.

Released at a similar time to the previous two models was the conceptual framework used by IPBES (Díaz et al., 2015a), adapted only slightly since to integrate the language of 'contributions' in place of 'benefits' (Díaz et al., 2018). This model is similar to that used in the NEAFO, except for two features. First, the NEAFO model disaggregates services, goods/ benefits and values, whereas IPBES compile services and goods/ benefits. Second, the IPBES model offers alternative terminology for a number of nodes. Against each of three nodes 'Nature', 'Nature's benefits to people', and 'Good quality of life', alternative terminology is offered for how this concept might be interpreted from different knowledge traditions.

The attempt in the IPBES framework to fit language from non-Western knowledge traditions directly into a framework developed from the ES literature caused significant debate, with one particularly controversial paper referring to the framework as a 'Rosetta stone' for interpreting between different worldviews (Díaz et al., 2015b) (Figure 6). The issue at stake here is the primacy given to the system form that is clearly derived from Western conceptions of science and knowledge.

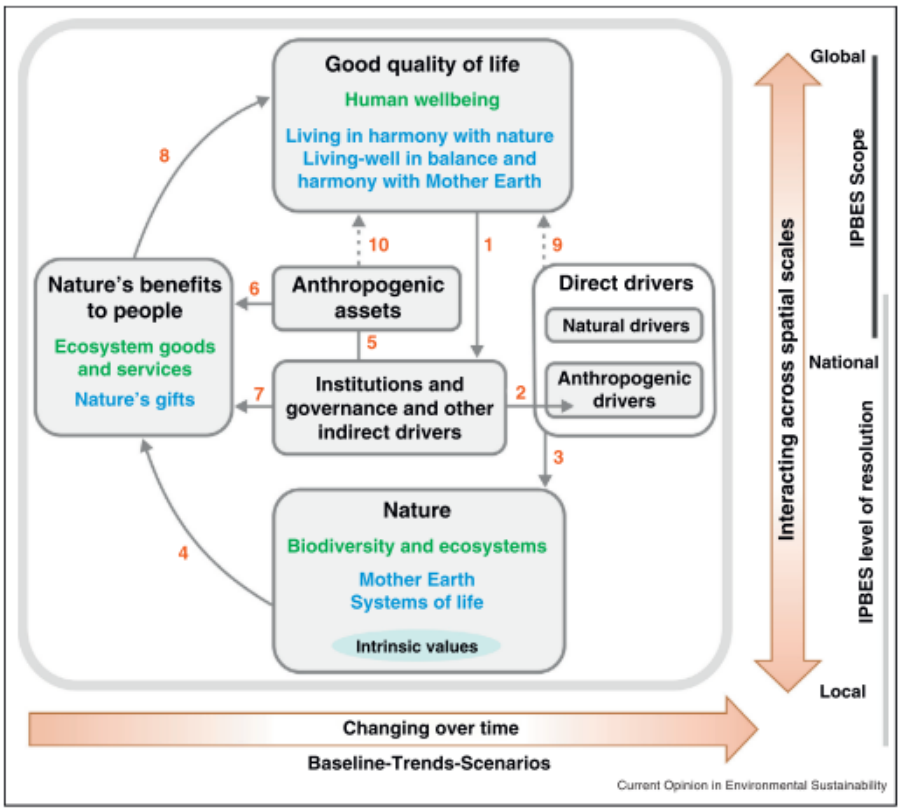

Figure 6. Conceptual model used by the IPBES, reproduced from Diaz et al. 2015a

This issue led to further developments in what is now the 'Nature's Contribution to People' (NCP) concept - a pretender to ES's throne that generated one of those strangely bitter battles that can only ever take place in the annals of academic journals (Braat, 2018; Kadykalo et al., 2019; Kenter, 2018; Maes et al., 2018; Pascual et al., 2017; Peterson et al., 2018).

A final model I consider is that developed by Costanza et al. (2017) (Figure 7) in their twenty-years-on reflection on the developments in ES since their 1997 paper. This model integrates many elements of previous versions, with a few exceptions. Firstly, it disaggregates the black box of 'natural capital' to better capture the internal dynamics of ecological processes. Second, the model attempts to integrate elements of ES categorisation by representing cultural, regulating, and provisioning services separately (See section 1.3). Finally, it recognises a system boundary and attempts to represent the material and energetic system inflows and outflows. The significance of these innovations in Costanza's model is that they situate the ES concept firmly within a world view more familiar to ecological economics than

neoclassically derived environmental economics. The standard ecological economic framework for representing the relationship between the biosphere and economic activity is presented in Figure 8, to demonstrate this point (Hammond, 2009).

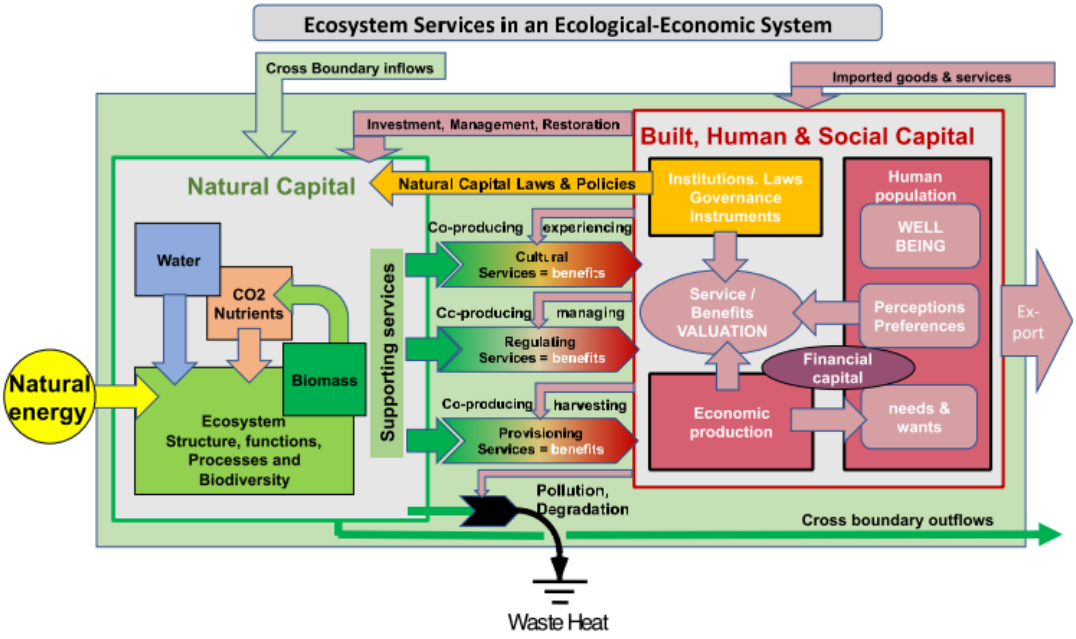

Figure 7. Conceptual model of ecosystem service provision, reproduced from Costanza et al. 2017

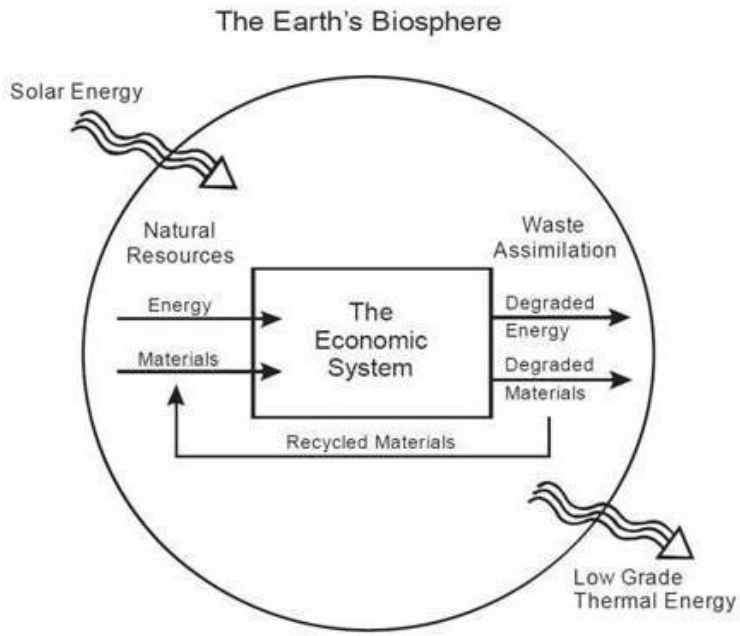

Figure 8. Conceptual model of relationship between biosphere and economic system common to the discipline of ecological economics, reproduced from Hammond et al. 2009

The difficulty in agreeing a shared set of system nodes and relational representations is significant for two reasons. First, it is indicative of a broader inability for those engaged with the ES concept to form a shared agreement regarding exactly what is meant by the concept. Even those academically engage with the concept are unlikely to be aware of the full range of conceptual models and related debates. This issue is exacerbated further when policy makers and other stakeholders attempt to adopt the concept. Second, much of the variation between conceptual models stems from the difficulty of drawing boundaries between different elements of socio-ecological systems. This reflects the nature of ES as a hybrid natural-social science concept and reflects the challenges of bringing together concepts from multiple academic disciplines.

1.3 CATEGORIZATION SYSTEMS

Alongside conceptual models, a wide range of ES categorisation systems exist. These are less revealing of the evolution of ES than conceptual models, so I will not compare them in detail. Figure 9 has been reproduced from Costanza et al. (2017) and highlights the degree of similarity between four of the most common categorisation systems, the original list offered in Costanza et al. (1997), the categories used by the MEA (2005), by TEEB (2010) and the Common International Classification of Ecosystem Services (CICES).

All approaches include the standard four categories of cultural, supporting, regulating and provisioning services. The main distinction of note between categorisation approaches is the boundary between supporting services, final services, goods, and benefits. This issue has not caused the same level of ongoing debate as other conceptual issues within ES. Its main significance to this thesis regards the complexity it introduces to economic valuation, in a risk of double counting. Yet all currently used systems succeed in overcoming this difficulty in a manner that is, at least, internally consistent, for example the system used by the NEA follow-on project pictured in Figure 10 (Albon et al., 2014). It is worth noting that although each system is similar, and internally consistent, different categorisations systems persist and efforts at unification across ES research have not yet been successful.

	Costanza et al., 1997	Millennium Ecosystem Assessment, 2005	TEEB, 2010	CICES (v. 2017?)
Provisioning	Food production *(13)*	Food	Food	Biomass - Nutrition
	Water supply *(5)*	Fresh water	Water	Water
	Raw materials *(14)*	Fibre, etc.	Raw materials	Biomass - Fibre, energy & other materials
		Ornamental resources	Ornamental resources	
	Genetic resources *(15)*	Genetic resources	Genetic resources	
		Biochemicals and natural medicines	Medicinal resources	
	X	X	X	Biomass - Mechanical energy
Regulating & Habitat	Gas regulation *(1)*	Air quality regulation	Air purification	Mediation of gas- & air-flows
	Climate regulation *(2)*	Climate regulation	Climate regulation	Atmospheric composition & climate regulation
	Disturbance regulation (storm protection & flood control) *(3)*	Natural hazard regulation	Disturbance prevention or moderation	Mediation of air & liquid flows
	Water regulation (e.g. natural irrigation & drought prevention) *(4)*	Water regulation	Regulation of water flows	Mediation of liquid flows
	Waste treatment *(9)*	Water purification and waste treatment	Waste treatment (esp. water purification)	Mediation of waste, toxics, and other nuisances
	Erosion control & sediment retention *(8)*	Erosion regulation	Erosion prevention	Mediation of mass-flows
	Soil formation *(7)*	Soil formation *[supporting service]*	Maintaining soil fertility	Maintenance of soil formation and composition
	Pollination *(10)*	Pollination	Pollination	Life cycle maintenance (incl. pollination)
	Biological control *(11)*	Regulation of pests & human diseases	Biological control	Maintenance of pest- and disease-control
Supporting & Habitat	Nutrient cycling *(8)*	Nutrient cycling & photosynthesis, primary production	X	X
	Refugia (nursery, migration habitat) *(12)*	'Biodiversity'	Lifecycle maintenance (esp. nursery)	Life cycle maintenance, habitat, and gene pool protection
			Gene pool protection	
Cultural	Recreation (incl. eco-tourism & outdoor activities) *(16)*	Recreation & eco-tourism	Recreation & eco-tourism	Physical and experiential interactions
	Cultural (incl. aesthetic, artistic, spiritual, education, & science) *(17)*	Aesthetic values	Aesthetic information	
		Cultural diversity	Inspiration for culture, art, & design	
		Spiritual & religious values	Spiritual experience	Spiritual and/or emblematic interactions
		Knowledge systems	Information for cognitive development	Intellectual and representative interactions
		Educational values		

a) Costanza et al. (1997) did not make a division into main categories; numbers (1–17) refer to Table 1
b) CICES is still in development. The list included here is v. 4.3 downloaded on 7 May 2017 from https://cices.eu/cices-structure/.

Figure 9. Comparison of four main ecosystem service categorisation systems, reproduced from Costanza et al. 2017

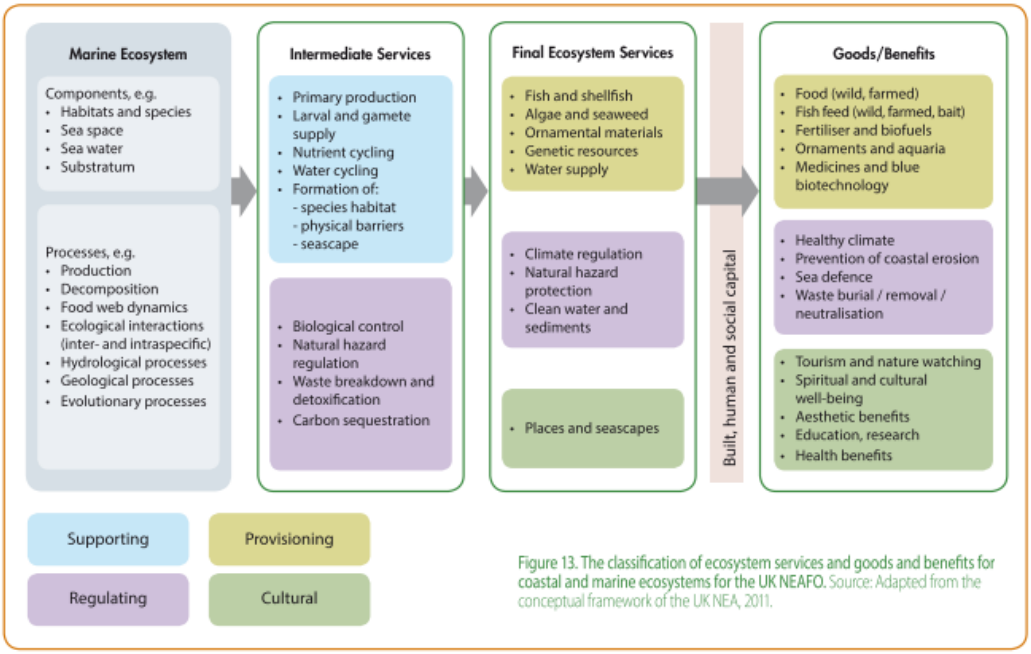

Figure 13. The classification of ecosystem services and goods and benefits for coastal and marine ecosystems for the UK NEAFO. Source: Adapted from the conceptual framework of the UK NEA, 2011.

Figure 10. Ecosystem service classification system used in the UK National Ecosystem Assessment Follow-On project, reproduced from Albon et al. 2014

1.4 REDUCTIONIST OR PLURALIST

In addition to a lack of consensus regarding conceptual models and classifications, the ES literature is also characterised by a running critique and riposte between the concepts detractors and defenders (Schröter et al., 2014; Schröter and Van Oudenhoven, 2016; Silvertown, 2015; Wilson and Law, 2016). There are debates revolving around what the concept implies about the human-nature relationship, the possible oversimplification of complex systems, the nature of environmental values and differing metaethical traditions (Fanny et al., 2014; Jacobs et al., 2016; Jax et al., 2013; Kenter et al., 2015; Norgaard, 2010; Redford and Adams, 2009; Schröter et al., 2014; Silvertown, 2015; Vira and Adams, 2009; Wilson and Law, 2016).

Some supporters of the ES concept adopt an uncritically positive position. These proponents are unequivocally supportive of placing a price on the natural world as a way of rendering it visible to policy makers who are supposedly only interested in market values. This potentially naïve position is the one that has been the target for much of the literature that is critical of the ES concept. I define the concepts 'defenders' not as those who uncritically embrace ES within a wider neoliberal discourse, but those that engage with and attend to critiques of the concept.

In the following sections (1.4.1, 1.4.2,and 1.4.3), I discuss three of the main critiques of the ES concept and the responses offered by the ES community. In Section 1.4.4 I make the case that these critiques can be seen to share the accusation of reductionism, and that by contrast the responses emphasise the possibilities for ES to bring a pluralistic and nuanced view of the human-nature relationship to policy and decision making. These contrasting interpretations of the ES concept are a major theme that I return to throughout the thesis.

1.4.1 Which value types are captured by the ES concept and which are excluded?

Criticisms of the values that are foregrounded by the ES concept are of two distinct varieties. The first is that only individual instrumental values are captured. These values are self-regarding and focused only on the benefit gained from a given ES. This criticism has been raised by those concerned that ES will crowd out alternative justifications for environmental protection that are premised on other regarding, intrinsic or relational values (Chan et al., 2016; McCauley, 2006; Redford and Adams, 2009; Sagoff, 2008; Silvertown, 2015).

The second concern is not linked to the ES concept per se, but to criticisms of neoclassical economics. Concerns that the ES concept entails 'putting a price on nature' are more accurately concerns about neoclassical valuation techniques are applied to a wider range of environmental goods and services under the rubric of ES (Kenter et al., 2016c; Kenter, 2017; Ryan and Spash, 2011; Silvertown, 2015; Spash and Vatn, 2006). Neoclassical economics adopts a subjective understanding of value based on the preference satisfaction experienced by the consumer. The value of something is defined by how much someone wants it, or more precisely the utility they gain from consuming an additional unit of it (known as the marginal utility theory of value). Individual preferences are subjective, meaning they are known only to the consumer and require no external justification (O'Neill et al., 2008). Preferences are held to be generally preformed, relatively stable over time, and complete. That is, a consumer should be able to express their preference for any given bundle of goods and services they are presented with as compared to an alternative bundle.

This very specific understanding of value is the premise on which the supposed supremacy of markets is based. Markets are seen to play an essential role in computing information on individual preferences from all the consumers in the market to establish a price that ensures efficient allocation of resources.

This conception of value is both problematic in its own terms, as well as in its justification for markets as the most suitable institutional form for natural resource governance. I discuss three distinct problems with marginal utility theory as it relates to ES valuation. First, markets do not exist for the majority of ES and their market price is unknown. Valuation of these services therefore requires a hypothetical market transaction to elicit a stated willingness-to-pay. So called 'stated preference' approaches are common in ES research (Daly-Hassen, 2013; European Commission, 2008; Pandeya et al., 2016). Yet people typically do not hold well-formed preferences regarding complex environmental goods, and thus violate a basic assumption of such approaches (Bartkowski and Lienhoop, 2018; Brouwer et al., 1999a; Czajkowski and Hanley, 2015; Kenter et al., 2011, 2016c; Lienhoop and Macmillan, 2007a; Macmillan et al., 2006; Szabó, 2011; Völker and Lienhoop, 2016). Second, the adoption of a subjective theory of value disregards the inputs required to produce a given good or service, as well as the possibility that one's preferences should require any ethical justification. Finally, by defining value as

utility, all value types are reified to one type (O'Neill et al., 2008). This condenses a plurality of potentially incommensurable value types down to one unit of account. More concretely, this suggests that in principle everything of value to a person is replaceable by something of commensurable value. The difference in value between that of one's child and of a banana can be understood only quantitatively - they are qualitatively identical.

In response to these criticisms of neoclassical valuation theory and techniques, researchers working within the ecological economic tradition have emphasised, and developed methodologies to capture, a range of value types (Irvine et al., 2016a, 2016b; Jacobs et al., 2016; Jax et al., 2013; Kenter et al., 2015; Kenter, 2016a). This work typically understands the process of valuation more broadly as 'assigning significance' rather than assigning a price. One of the most comprehensive explications of different types of environmental values is presented by Kenter et al. (2015). These authors identify four value dimensions: value provider, value concept, value intention and value scale. Value providers can be individuals, or groups and communities expressing shared values. The value concept moves from broad, transcendental values, through contextually specific values, to value indicators (e.g. monetary metrics). Value intention can be other regarding or self-regarding and scale can include both individual and society scales. This framework allows the integration of a much wider variety of value traditions and types.

In addition to axiological considerations (those related to values and valuation), Jax et al. (2013) make the case for including deontological ethics in ES research. In contrast to the consequentialist metaethics of utilitarianism often supposed to be central to ES, these authors make the case for the consideration of rights and duties. Bringing in deontological ethics heightens the need to consider incommensurability in valuation approaches. This framing also allows for ethical positions predicated on the rights of the non-human world, or our duties towards it. Chan et al. (2012b) include many of the value dimensions discussed by Kenter et al. (2015) but make the distinction between preferences, principles and virtues explicit, as well as introducing the possibility of biocentric value positions.

Adopting a wider understanding of values requires confronting the issue of incommensurability, undermining any claim for markets as the ultimate calculator of value. Certain value types my not be amenable to trade-offs or efficiency-based thinking. Methodologically, value plurality and incommensurability have driven an

interest in multi-criteria and deliberative approaches to valuation (Jacobs et al., 2016; Kenter, 2014). Authors such as Dendoncker et al. (2018) and Jacobs et al. (2016) present approaches to 'integrated valuation' that bring together ecological, socio-cultural and economic valuation tools to develop a holistic approach to assigning importance. Authors like Kenter et al. (2016a) and Lo and Spash (2013) focus on deliberative valuation. Introducing deliberation to valuation processes allows conflicting value types to be brought out and discussed, whilst also providing opportunity for participants to gain a more thorough understanding of the goods and services being valued.

1.4.2 Will ES lead to the commodification of nature?

Related to the valuation debate are concerns that the ES concept necessarily implies a move to commodify nature. The drive to turn nature into a commodity such that it can be integrated into markets is potentially two-fold. Firstly, through the neoclassical lens, environmental degradation is conceived of as a market failure problem, or even a problem of the absence of any market (Martino et al., 2019). Resource depletion and pollution are not integrated into market prices – they are an externality in need of internalising. This same school of thought understands the depletion of common pool resources as a 'tragedy of the commons', where a lack of ownership rights and open access leads to resources being depleted or degraded (Hardin, 1968). The issue of environmental degradation is therefore seen as one of lack of market completeness. The solution is to apportion and assign property rights to resources, and to develop mechanisms to integrate the cost of extraction and pollution in the market prices of commodities. From this perspective, ES provides a conceptual tool for apportioning 'nature' in such a way that it can be integrated into existing markets, or to create new markets for these services.

The second impetus towards commodification comes from the nature of capitalist expansion. As resources are depleted or markets saturated, capitalism must expand to integrate more resources and develop new markets. Part of this process is the expansion of so-called 'commodity frontiers', the conversion of new supplies of land and resources into marketable commodities. Again, by providing the apparatus to apportion nature into definable services and attach a price to these, the ES concept may facilitate the expansion of new commodity frontiers (Goméz-Baggethun and Perez, 2011; Robertson, 2006, 2004). Such concerns are likely heightened by the

high profile and rapid adoption of Payment for Ecosystem Services and Markets for Ecosystem Service schemes (Kull et al., 2015).

Important work on this issue comes from Erik Gomez-Baggethun and his co-authors (Gómez-Baggethun et al., 2010; Goméz-Baggethun and Perez, 2011). Gomez-Baggethun argues that commodification of any given ES requires four distinct shifts: from a utilitarian framing, to monetisation in terms of placing a price upon, to appropriation, through to exchange. These authors argue that the potential exists for ES to set in train a process of commodification, but that few services have yet made it beyond the stage of monetisation. The number of truly operational markets for ES is small. There is a much larger number of PES schemes, but this term captures a range of institutional frameworks with most taking the form of negotiated subsidy rather than market transaction (Barton et al., 2017; Jespersen and Gallemore, 2018; Robinson et al., 2016).

The degree to which the logic of commodification is inherent to the ES concept is debatable. Though a utilitarian framing an allocation of market prices are common in ES studies, the next two steps of appropriation and exchange are less commonly observed (Daly-Hassen, 2013; Millennium Ecosystem Assessment, 2005; Schröter and Van Oudenhoven, 2016). The most obvious case where this chain of conceptual steps is complete is in markets such as the European Union's Emissions Trading Scheme. These represent the commodification of the capacity for the biosphere to process a given amount of carbon. Yet even for this simple and relatively easily quantified ES, market functionality is questionable (Mcafee, 2012; van der Hoff et al., 2019). The assimilative capacity of the biosphere is a common pool resource, as such scarcity has to been artificially created through the production of credits. This introduces the possibility of political interference. In many instances the quantity of credits remains high, suppressing costs and failing to stimulate the desired change in economic activity. Equally it is not clear that the ES concept is a necessary precondition to carbon markets, these having developed before the ES concept gained widespread popularity. The difficulty of establishing markets even for this relatively simple ES demonstrates that the process of commodification is far from a certainty.

The degree to which the ES concept facilitates commodification is still an open debate. However, a tendency towards commodification is best understood in the wider context of neoliberal governance and discourse, rather than as implicit in the

ES concept (Dempsey and Robertson, 2012; Robertson, 2006, 2004). As I identified in Section 1.1, the ES concept did not grow out of this neoliberal discourse, it emerged from the nature conservation community originally as a pedagogical tool. Commodification requires something be disembeded from its context and shorn of specificity and contextual meaning. It must move from a specific to a generality as to be interchangeable and transferable. A pluralistic understanding of values and ethics, and an appreciation of the complexity of socio-ecological systems, highlights the contextuality and contingency of many ES. These features bring into clarity the inappropriateness of markets as a form of mediation for many ES. It can be argued that ES commodification represents a co-option of the concept rather than an inherent feature.

1.4.3 Complexity blinder

The final concern I will discuss is that of ES as a 'complexity blinder' (Norgaard, 2010). This is the risk that the ES concept, in rendering the natural world as a series of stocks and flows, overlooks the dynamic behaviour of socio-ecological systems. This becomes a risk if system dynamics are not considered and tipping points transgressed, or feedback loops locked in, as a result of human action. This risk may be exacerbated if attempts are made to 'efficiently' use ES. That is, operate under the belief that we understand stocks of natural capital well enough to extract the maximum benefit from them without causing harm. For example, if we do not view a high level of biodiversity as a 'good' in its own right, and determine that similar services flows can be delivered at lower levels of biodiversity, we risk losing the functional redundancies that give ecosystems their resilience (Norgaard, 2010; Ridder, 2008; Schröter et al., 2014). Marginal analysis used in neoclassical economics is also incapable of dealing with non-linearities and threshold level effects (Farley, 2012).

There are also specific concern regarding the over-simplification of 'cultural services' within the ES framework (Chan et al., 2011, 2012b; Fish et al., 2016c; Propper and Haupts, 2014; Stenseke and Larigauderie, 2018; Winthrop, 2014). These services are less tangible, and the complexity of culture risks being rendered as simplistic notions such as 'recreation'. Some critics contend that cultural services cannot be thought of as a flow of service delivered by a stock of capital (Propper and Haupts, 2014; Winthrop, 2014). Instead, culture is best understood as a relational process of meaning making between the human and non-human world

(Graeber, 2001; Winthrop, 2014). Culture should therefore not be seen as a distinct ES, but as a structuring context, belief system or worldview, in which humans interact with the world. Whilst some have taken this as a reason to reject the ES concept, others have sought to reconceptualise cultural services to address such concerns (Chan et al., 2012a; Díaz et al., 2015a; Fish et al., 2016c).

The poor conceptualisation of cultural ES is arguably the result of insufficient engagement from the social sciences, as well as the arts and humanities (Church et al., 2014; Edwards et al., 2016; Fish et al., 2016a). Emerging from the confluence of ecology and economics, the need to broaden the disciplines and knowledge types brought to bear on the study and assessment of ES has long been acknowledged (Potschin and Haines-Young, 2011). Although disciplinary diversity in the field has grown since its inception, it is still dominated by the natural sciences. This can be seen for example in the disciplinary backgrounds of IPBES experts, where it has been acknowledged that more social and humanities expertise are needed (Díaz et al., 2018; Timpte et al., 2018).

As with other concerns, a case can be made that oversimplification is not inherent to the ES concept. As I discussed in Section 1.2, conceptual models are becoming increasingly complex. Some ES research adopts insights from complex system theory, and increasingly efforts are made to bring a range of academic and non-academic knowledge to bear on ES assessments (La Notte et al., 2017). What matters is how the ES concept is translated into practice, and ensuring the complexity is not lost in the process.

1.4.4 Reductionism vs pluralism

That the ES concept should generate such divergence and disagreements is hardly surprising. ES transect the fields of expertise of various disciplines and the concept actively draws in stakeholders from outside academia. Given this, it seems reasonable to argue that the answer to Nahlik et al.'s (2012) exasperated cry of “where is the consensus?”, is simply to question whether there could ever be one, or even whether it would be a good thing if there were.

The discussions presented in Sections 1.4.1, 1.4.2 and 1.4.3 around values, commodification and complexity represent some of the main battle grounds in debates over the ES concept. A key theme running through these critiques is the risk of reductionism. In values, there is a risk that a plurality of values are reified to

one type at the expense of others. Commodification depends crucially on a reductionist view of both the natural environment, and human-nature relations. And ES becomes a complexity blinder only if the simple boxes drawn on conceptual diagrams of ES start to become the way we think about the world. For each of these arguments, there is a body of ES research seeking to avoid the pitfall. This shows two things. First, that the meaning of the ES concept is still contested in more fundamental ways than conceptual divergences outlined in Section 1.2. Second, that the ES concept holds multiple potentialities, and that which of these is fulfilled has huge implications for the types of institutional logics that are brought to bear on environmental challenges.

The reductionist form of ES represents a gross over-simplification of the complex human-nature relationship and the role that nature plays in people's lives. This form of ES risks reducing the human-nature relation to a purely extractive one and reducing all values to preference satisfaction. On the reverse side, the ES concept has the potential to bring together pluralistic and diverse understandings of the human nature relationship. It does this in part by acting as a boundary object to facilitate collective endeavours between researchers and practitioners from diverse disciplinary and cultural backgrounds. The field of environmental valuation has been advanced dramatically both conceptually and methodologically by those working under the ES rubric. Far from being a complexity blinder, viewed through a complex systems lens, the ES concept can again act as a boundary object to facilitate communication between a wide range of disciplines to bring together a more complete, nuanced understanding of these systems and their responses to anthropogenic pressures.

Having discussed the range of understandings and debates that surround the ES concept, in the following section (1.5) I present a working definition of the ES concept capable of accommodating this diversity.

1.5 WHAT IS THE ECOSYSTEM SERVICES CONCEPT?

The ES concept is not a concept of pure science, no single discipline lays claim to it and there are no processes it gives form to that do not appear in the academic literature or popular consciousness under another name. We had the language to discuss, study and value fish stocks, carbon sequestration, and beautiful scenery before the ES concept emerged. I have defaulted to describing it here as a

‘concept’, but it has also been variously described as a framework, a discourse, and a metaphor (Norgaard, 2010; Spangenberg et al., 2014). As has already been discussed, the precise meaning and content of the of ES concept is highly contested and multiple discourses exist regarding its structure and purpose (Hermelingmeier and Nicholas, 2017). Yet, most people who use the term share at least a minimal degree of understanding. It is this ‘sameness’ of different interpretations that I look to as the starting point for a working definition of the concept.

A definition of the ES concept must be specific enough to account for a level of shared understanding, but flexible enough to allow for the multiple perspectives that are attached to it. I define the concept as having both analytical and normative content. By analytical content, I mean the constructs it provides to assist the comprehension and ordering of infinitely complex ‘reality’. By normative content, I mean the implicit claims the concept makes about what is good and valuable.

The analytical content I believe is common across all articulations of the ES concept covered in Sections 1.2, 1.3 and 1.4 and has three aspects. First, is the establishment of a clear distinction between the human and non-human. Second, is the emphasis on the unidirectional flow of benefits from the non-human to the human. Finally, is the differentiation and categorisation of these benefits. I do not go so far as to identify specific categorisations within this basic definition, as ongoing debates such as the status of cultural values mean that there is no basic typology that is universally agreed upon. However, the notion that benefits are multiple and can be distinguished and specifically assessed is foundational to the concept. As discussed in Section 1.4.3, it is possible to find examples in the literature that frame ES, especially cultural services, not as a unidirectional flow but as embedded in a relational process of meaning making (Chan et al., 2016; Fish et al., 2016c). Some see this as the basis to reject the ES concept (Winthrop, 2014). Others see the potential for accommodation, but are explicit that this would require a fundamental reconceptualization (Propper and Haupts, 2014). Even the later position accepts the basic analytical content I identify as the essence of the ES concept – even if only to attempt to redefine it.

The basic analytical content of the ES concept provides only a very limited power to assist in describing and ordering inquiries into the ‘real world’. It is therefore necessary to flesh it out with more detailed conceptual frameworks – hence the diversity of examples I set out in Section 1.2. However, this lack of analytical power

is also a potential strength. In Section 1.6 I explain how this feature of the concept allows it to function as a 'boundary object'.

The normative dimension of the ES concept is again threefold. At a foundational level, the analytical separation of human and nature is itself culturally and historically specific and structures the types of ethical claims it is possible to make about the underlying system (Castree, 2014; Demeritt, 2001; Latour, 1993). More explicitly, the ES concept implies that certain configurations of socio-ecological systems are of more or less value to humans, and that we should consider this value when acting in the world. Finally, the concept implies an element of holism – by which I mean the notion that we should consider as full variety as possible of the benefits humans gain from the non-human world, as opposed to focusing on individual benefits or a small subset.

My definition of ES utilised here therefore has six features - three relating to its analytical, and three to its normative content (summarised in

Figure 11). I believe this definition can accommodate all of the debates thus far discussed regarding the ES concept.

Analytical	Normative
Human-nature dualism	Human-nature dualism
Unidirectional flow of benefits	Anthropocentric
Differentiation of benefits	Holism

Figure 11. Summary of features of working definition of ecosystem services

1.6 ECOSYSTEM SERVICES AS A (CONTESTED) BOUNDARY OBJECT

Calling the ES concept (or anything) a boundary object is a claim about its function more than its ontological status. Boundary objects are constructs that are amorphous enough to be adapted to different contexts and worldviews, but are robust enough to act as a channel of communication between these different positions (Star and Griesemer, 1989). Boundary objects typically have a more rigorous demarcation and form in particular communities, but are more weakly structured at the level of common understanding (Huvila, 2011). This is compatible with the understanding of the ES concept that I outlined above. Certain user groups will seek to internally clarify what they mean by ES. A policy maker's understanding

of the concept is likely to have more in common with that of another policy maker than an ecologist or an economist. Similarly, two ecologists are likely to share a common understanding of the concept that will differ from that of an economist. Yet, it remains true that a member of any one of these communities will have some level of shared understanding when using the term across the boundary with another group.

Boundary objects play a functional role in facilitating communication between different groups, bringing different ideas and framings into discourse whilst ensuring a level of common understanding. A number of studies explore how the ES concept functions as a boundary object in different contexts (Abson et al., 2014; Galler et al., 2016; Hermelingmeier and Nicholas, 2017; Jadhav et al., 2017; Kull et al., 2015; Schröter et al., 2014; Steger et al., 2018). The operation of the ES concept as a boundary object is a theme that I pick up further in Chapters 3 and 4.

The position I begin this thesis from is that the ES concept should be considered a contested boundary object. The core of the concept is broadly understood, but this core is non-specific enough to allow multiple interpretations to be projected onto it. This allows the concept to play a functional role as a boundary object, but also presents the possibility of reductionist interpretations, with the attendant risks of commodification. This thesis explores these tensions, with the primary purpose of guiding an understanding and operationalisation of the ES concept that avoids a reductionist, and potentially dangerous, interpretation.

In the remainder of this chapter I briefly introduce literature on the operationalisation of the ES concept drawn upon in this thesis (Section 1.7), before presenting my reserach objectives, questions and approach (Sections 1.8 and 1.9).

1.7 UNDERSTANDING UPTAKE OF THE ES CONCEPT AND THE BARRIER OF DIVERSITY

The proliferation of categorisation systems and conceptual models, and continuing debates within the field, have been flagged as a potential barrier to the use of the concept in practice (Nahlik et al., 2012; Polasky et al., 2015). As McDonough et al. (2017, p 83) state, ‘Though discussion over terminology and methodology is expected in the establishment of a new field, the prolonged inability to achieve consensus may pose a challenge for policy- and decision-makers who aim to

incorporate the ES concept into their respective organizations.' This may explain why early literature on the 'use' of ES knowledge showed a lack of clear impact on decision outcomes (Billé et al., 2012; Laurans et al., 2013). However, there are also numerous ways of understanding the 'use' of the ES concept. I divide understandings of 'use' into two categories, those focused on the effect that research and evidence on ES has on a specific decision, and the institutionalisation of the ES concept in the standard practices of policy and decision making. It is the second of these that this thesis is primarily concerned with.

1.7.1 Operationalisation as 'knowledge use'

The simplest way the question of operationalisation has been addressed, has been to pose it as a question of knowledge use. That is, to ask, 'to what degree has knowledge generated using an ES framework been used in a specific decision or policy design?'. Studies such as Billé et al. (2012) and Laurans et al. (2013) seek to identify cases where ES studies have directly impacted on decisions, with minimal success. However, this is just one type of 'knowledge use'. A more nuanced view, derived from an extensive scholarship on knowledge use in public policy, paints a more optimistic picture of the extent to which ES assessments are starting to influence environmental decision making. This literature draws from the pioneering work of Carol Weiss in the 1970s, which makes a distinction between instrumental and conceptual knowledge utilisation (Weiss, 1979).

Research suggests that most of the impact from ES knowledge may come from conceptual, not instrumental use (Posner et al., 2016; Ruckelshaus et al., 2013; Saarikoski et al., 2018). Instrumental knowledge use is the type most typically thought of when imagining the interface between knowledge and policy. Information that is pertinent to a policy question is generated by experts, this work points to the most appropriate course of action, which is then followed by those in charge. This is contrasted with the conceptual mode of knowledge use, which is also referred to as the 'enlightenment' model. In this mode, the accumulation of a body of evidence over time influences the broader policy agenda, or the way in which policy actors go about making decisions (Dunlop, 2014; Owens, 2005; Russel et al., 2016; Weiss, 1979). Evidence suggests it is the conceptual mode that is the most common channel through which ES knowledge impacts on decisions (Haines-Young and Potschin, 2014; Halpern et al., 2013; Waylen and Young, 2014).

1.7.2 Operationalisation as institutionalisation

Studies on knowledge use identified in Section 1.7.1 typically focus on specific policy-researcher collaborations, where funded research projects are established to work with policy makers to undertake ES assessments for a specific purpose. This is the most easily identifiable 'use' of the concept. However, the long-term impact of the concept can only be assured if it becomes embedded in actual decision-making institutions and becomes part of the common practice of decision making. A growing body of work therefore analyses the institutionalisation of the concept in policy and governance arrangements (Bezák et al., 2017; Bouwma et al., 2018; Goméz-Baggethun and Perez, 2011; Matzdorf and Meyer, 2014; Mauerhofer and Laza, 2018b; McKinley et al., 2018; Rozas-Vásquez et al., 2018; Saarikoski et al., 2018). It is this process of institutionalisation that this thesis primarily focuses on, and I discuss this existing literature in detail in Chapter 3.

1.8 RESEARCH OBJECTIVE AND QUESTIONS

Above I have mapped out the main disputes and discussions within the ES literature that this thesis seeks to contribute to. I have identified two key potentialities for the ES concept. ES can be a reductionist conception that risks the creeping commodification of nature, or a vehicle to better reflect the myriad and complex ways humans benefit from and value nature into how decisions are made. This thesis aims to contribute towards operationalising the ES concept in a manner that reflects the latter of these two potentialities. To this end I have two key objectives, the first exploratory and second prescriptive:

1- To explore the process by which the ES concept is embedded in governance practices, and how this process shapes and is shaped by competing potentialities within the ES concept
2- Identify principles and approaches to the operationalisation of the ES concept that avoid reductive tendencies within the concept and reflect the complexity of the human-nature relationship

I approach these objectives by answering three main research questions:

Q1. What principles should guide the operationalisation of the ES concept?

Q2. How does the ES concept interact with existing institutions when put into

practice, and what are the implications of competing tendencies inherent in the concept?

Q3. How should assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

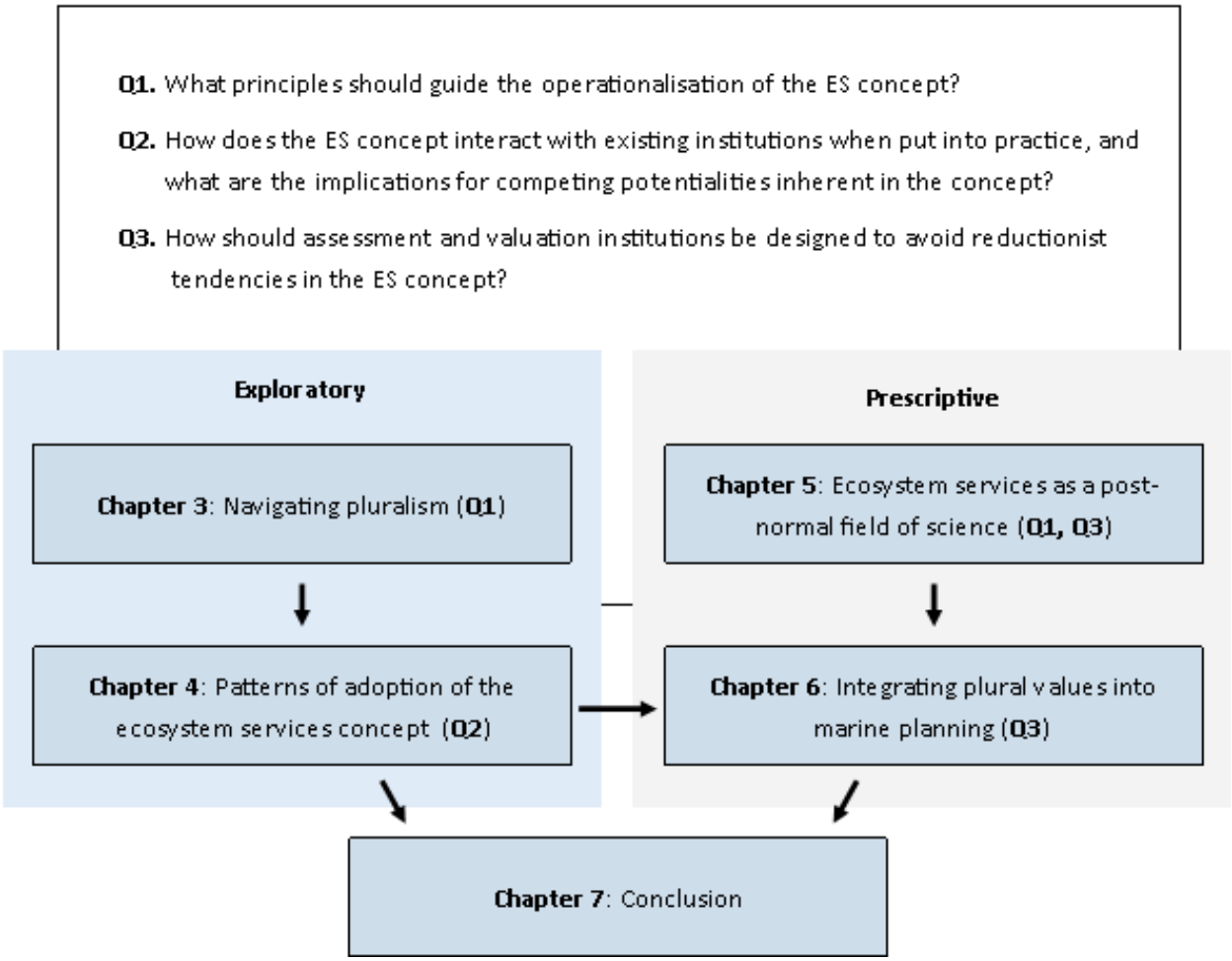

Figure 12. Graphical representation of link between each section of thesis and which research questions are addressed by which chapter. Arrows represent the continuation of ideas and themes between chapters.

1.9 METHODOLOGY AND OVERALL RESEARCH APPROACH

This thesis addresses both practical and conceptual questions regarding the ES concept. It seeks to both answer distinct questions about how the concept is seen and used, as well as develop insights to help guide the concept's operationalisation. I have therefore deployed a variety of methods and forms of inquiry. In this section I

give an overview of each chapter, the methodologies adopted and how it relates to the objectives and questions of the thesis.

The core content of the thesis, Chapters 3, 4, 5 and 6, are organised as a series of papers. Chapters 3 and 5 are published and Chapters 4 and 6 are awaiting submission (Ainscough et al., 2019, 2018). The thesis is structured to maintain these manuscripts in their original form. I have therefore added an introductory ('Foreword') and closing ('Afterword') section to each chapter to frame it in the overall context of the thesis. My understanding of the ES concept, and insights pertaining to the core themes of the thesis have emerged and developed over the course of the project. I use the closing section of each chapter to explain how the work shaped my own thinking and understanding.

The chapters are not presented in the order the work was undertaken. I have arranged them to best represent the conceptual links between papers and to facilitate the overall flow of the thesis. Below I introduce each chapter, the methodology used and how it relates to my research questions (summarised in Figure *12*).

1.9.1 Chapter Three: Navigating pluralism: Understanding perspectives of the ecosystem services concept

This chapter uses a combination of mixed method survey design and participatory workshops to examine the views and perspectives on the ES concept among different user groups. It seeks to identify points of contention and agreement, as well as what different groups understand the ultimate purpose of the concept to be.

Data are taken from a survey of participants of the European Ecosystem Services Conference (EESC) in Antwerp in 2016. The survey was distributed to participants prior to the conference, and workshops were held at the conference to discuss themes from the survey. These data were then subjected to thematic content analysis to identify key themes relating to concerns and priorities for the ES concept. A number of guiding principles are identified for avoiding misuse of the ES concept and published as the 'Antwerp Declaration'.

Starting from the understanding of the ES concept as a boundary object, as set out in Section 1.6, I argue that this function conflicts with the needs of policy makers. For a concept to become part of their decision-making process, policy makers require that the ambiguity around the concept be settled. This is in tension with the

prevailing lack of consensus. I reconcile this contradiction by developing a conceptual framework that sees the ES concept playing a dual role, both as a boundary object, and as a contextually defined concept embedded into institutions. Through this framework I discuss how the process of institutionalisation can influence how the ES concept is defined and interpreted. This is a dynamic that I then explore in more detail in Chapter 4.

Research question addressed:

> **Q1.** What principles should guide the operationalisation of the ES concept?

1.9.2 Chapter Four: Patterns of adoption of the ecosystem services concept in Scottish inshore marine governance

Chapter 4 explore the process of institutionalisation of the ES concept through a case study of inshore marine governance in Scotland. For this chapter I undertook a policy analysis to understand the uptake of ES into formal policy frameworks, adopting a methodology developed by Bouwma et al. (2018). I then gathered data through semi-structured interviews with key informants working in industry or public bodies in the marine and coastal governance sector. I coded the data to identify key drivers of change with different institutional contexts, specific uses of the ES concept and barriers to its further adoption (Glaser and Strauss, 1967).

I use these data to explore how features of the ES concept interact with existing institutional forms as well as prevailing norms and policy priorities. I conclude that in Scotland the ES concept is being adopted in the marine realm primarily in the context of regional planning, and that its use is shaped both by inherent features of the ES concept, as well as prevailing trends towards devolution of decision making and participatory and adaptive forms of government.

Research question addressed:

> **Q2.** How does the ES concept interact with existing institutions when put into practice, and what are the implications competing tendencies inherent in the concept?

1.9.3 Chapter Five: Ecosystem services as a post-normal field of science

Chapter 5 marks the start of the more explicitly prescriptive part of the thesis. Although the principles identified in Chapter 3 could be seen as prescriptive, these were empirically grounded in a survey of ES concept users. Chapter 5 asks what

type of design principles should be adopted for ES assessment that reflect the pluralist understanding I am seeking to support in this thesis. I develop an argument for a post-normal science approach to such assessments, explore the degree to which current ES research adopts such an approach, and discuss potential advantages of an explicit turn towards post-normal science in ES research. This is primarily a conceptual chapter but also presents the findings of a systematic literature review into the adoption of a post-normal science framing in ES research.

Research questions addressed:

> **Q1.** What principles should guide the operationalisation of the ES concept?
>
> **Q3.** How should assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

1.9.4 Chapter Six: Integrating plural values into marine planning: The perceived legitimacy of Democratic Deliberative Monetary Valuation

In the final empirical chapter, I attempt to draw together the insights from previous chapters to develop a methodology for ES valuation. This methodology is designed to capture social and cultural values in the type of devolved, participatory governance setting identified in Chapter 4. It responds to the importance of capturing plural values through ES assessments identified in Chapter 3 and is developed using a post-normal science framework from Chapter 5. I present the results of a pilot valuation study in the context of regional marine planning in the Firth of Clyde. This pilot is designed to assess the perceived legitimacy of the valuation arrived at as compared to more standard stated preference valuation approaches.

Research question addressed:

> **Q3.** How should assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

1.9.5 Conclusion

I conclude by summarising the overall argument of the thesis. I reflect on how the different chapters of the thesis respond to my initial research objectives and questions. I then outline the core contributions to knowledge the thesis makes and identify potential areas for future research.

1.10 SUMMARY OF FINDINGS AND CONTRIBUTIONS TO THE FIELD

The following section provides a summary of the main findings and contributions of the thesis and the significance of these for the field of ES research and practice.

1.10.1 Principles to guide the application of the ES concept

Chapter 3 presents a number of principles for guiding the use of the ES concept, aimed at avoiding an overly reductionist approach. These were derived through from a survey of, and series of workshops with, members of the ES community. The principles are: the need to integrate the principles of sustainability, defined as equitably providing for the needs of the present generation without reducing the capacity for future generations to meet their needs; integration of a plurality of value types including social and cultural values; and engagement with a variety of knowledges through inter- and transdisciplinary working.

In relation to the latter two of the guiding principles suggested in Chapter 3, the thesis makes methodological contributions to the assessment and valuation. These contributions are outlined in Section 1.10.3 below.

Chapters 3 and 4 identify that there is no direct link between the ES concept and the principles of sustainability. Sustainable use implies the imposition of limits on the extraction or utilisation of finite resources or reliance on assimilative capacities. The case study in Chapter 4 fails to identify any successful uses of the ES concept in contexts that would directly result in additional limits being placed on economic activities. The primary purpose of the concept in the eyes of policy maker was as a tool for identifying stakeholder interests in the context of trade of analysis. On the basis of these findings, in Section 7.2 I reflect on the prospects for the ES concept to contribute to efforts to avert societies current unsustainable trajectory. I also make recommendations for integrating ES concept with the principles of sustainability in practice, these include: Setting of absolute limits on the aggregate level of extraction of vital forms of natural capital; integrating of the precautionary approach as foundational principles of all policy making; Encouraging and supporting the development of new, participatory decision making institutions; and using the ES concept to demonstrate the externalities caused by harmful economic practices.

1.10.2 Factors facilitating or hindering the integration of the ES concept into governance institutions

Chapter 4 identifies factors affecting the uptake of the ES concept in the context of inshore marine governance in Scotland. A number of general barriers are identified including: the lack of reliable data; difficulty of deriving accurate valuations; the lack of regulatory or legislative drivers; questionable legal defensibility of actions taken based on assessments of ES; the lack of any national performance indicator linked to ES; and competition between an ES framing and alternative approaches to policy formation.

Uses of the concept that had significant implications for the distribution of environmental resources were also less successful. This demonstrates the need to consider how existing institutions allocate benefits between stakeholders, and the potential for actors to defend existing institutional arrangements that benefit them.

Future attempts to adopt the concept may seek to directly address the above barriers, however the case study showed that they do not block uptake in all contexts. I also identify a number of factors that assist in the integration of the ES concept. These are: how new the institutional form is, with newer institutions being more likely venues for the integration of the ES concept; institutions dealing with whole geographical areas rather than distinct activities are more likely to adopt the concept; and the ability to accommodate relatively high uncertainty and lower levels of precision making a venue more likely to integrate the ES concept. Hence, as our study found, spatial planning is the most viable institutional form for adoption of the ES concept. Attempts to adopt the concept in the context of sectoral regulation or conservation policy have been less successful.

The major contribution of the concept was seen as being a tool to assist in trade off analysis. Though there was minimal consistency in precisely how the ES concept was defined between contexts. Contrary to some concerns regarding commodification, economic valuation was not central to policy actors understanding of the primary purpose of the ES concept.

I was also able to determine that existing norms and priorities are shaping the manner in which the ES concept is defined and integrated into environmental governance in the case study. The trend towards devolved decision making, participatory approaches to knowledge creation, and growing concern for climate change are all visible in how the ES concept is being deployed. Existing norms and

priorities in a given context are likely to influence if and how the ES concept is integrated into decision making. The presence of absence of supporting societal norms is likely to be an important aspect of ensuring the guiding principles identified in section 1.10.1 are realised in practice. As in many settings, the desire for economic growth was also an overriding imperative in all settings in my case study. This widespread societal norm is a barrier to efforts to integrate usage of the ES concept with the principles of sustainability.

1.10.3 Designing methods and institutional forms to better assess and value ES in policy and decision making

The third area the thesis contributes to is the design of ES assessment and valuation methodologies that respond to the identified guiding principles of integrating social and cultural values and adopting inter- and transdisciplinary approaches.

Chapter 5 presents guidelines for the adoption of a post-normal science approach to the assessment of ES (See Figure 23 for details). Post-normal science is an approach to knowledge creation and validation in contexts characterised by high uncertainty and conflicting normative positions. It provides a theoretical framework for integrating, assessing, and acting on knowledge claims from a range of epistemological positions – and therefore offers a firm grounding for expanding inter- and transdisciplinary approaches to ES assessment.

Chapter 1526 presents a novel methodology, built on a post-normal science framework, for valuing ES as part of a policy process. This method is designed to overcome issues of value plurality and incommensurability that are poorly captured or dealt with in other valuation approaches. The methodology, a form of Deliberative Democratic Monetary Valuation, is shown to result in valuations that participants feel more confident in as compared to more traditional approaches to environmental valuation. This perceived legitimacy is a crucial factor in arriving at valuations that may be used to inform policy and decision making. The methodology is described in detail and will be of interest to others interested in undertaking ES valuations to inform policy and decision making.

2 PHILOSOPHICAL POSITION AND POSITIONALITY

In this chapter I lay out the ontological and epistemological position underpinning my research and explain the origins of the research as a way to discuss my positionality as a researcher.

2.1 THE CRITICAL REALIST POSITION

In the previous chapter, and throughout the thesis, I discuss different conceptualisations of, and knowledge claims regarding, ES. In order to treat these in a systematic way it is necessary to explicate a position on the nature of knowledge (epistemology) and the reality it describes (ontology). To this end, in this section I present the 'critical realist' position I adopt through this thesis. I explain the critical realist position and its relevance to my understanding of the ES concept.

The positivist view of science as an objective pursuit of knowledge came under sustained criticism during the 1980s and '90s. Building on Thomas Kuhn's work on paradigm shifts, social constructivists began to scrutinise the process of scientific inquiry, emphasising the contingent and socially driven nature of knowledge production. This provoked a furious 'realist' backlash in the now infamous 'science wars' (Gross and Levitt, 1994; Jasanoff, 1996; Kuhn, 1962; Latour, 1987, 1979). Putting aside a unconstructive exchanges (e.g. Sokal, 1996), engaging in these debates has produced a more nuanced picture of the production of knowledge than either the positivist or hard constructivist position alone would have achieved.

Sheila Jasanoff's conciliatory 1996 article, 'Is science socially constructed – and can it still inform public policy' captures the value of the social constructivist's interrogation of knowledge production. Jasanoff argues that social constructivism need not relativize all knowledge, and recognises the significance of truth claims made by Western science (this is, after all, why such truth claims have been interesting objects of inquiry for Science and Technology Studies scholars such as Jasanoff). Yet, particularly in the policy process, social constructivism can help to illuminate the reasons behind contrasting (but honestly held) truth claims, delineating how and why disagreements emerge – something a positivist approach is not capable of doing. It is a fallacy to believe that constructivism is interested only in highlighting the contingency of knowledge claims. Instead, "the social study of science seeks to explain in detail what [the search for truth] looks like, and what it

means to say, in social terms, that truth has ever been found in a particular case" (Jasanoff, 1996, p 272). In ES research, knowledge claims can come from numerous academic disciplines as well as from non-academic knowledge holders. It is therefore important to be attentive to different processes of knowledge production, and perhaps more significantly, of knowledge legitimation.

Taking a social constructivist view of the acquisition of knowledge allows for the epistemologically pluralistic stance necessary in ES research. This is consistent with critical realism, with the corollary that critical realists insist on a realist ontology – avoiding the potential for the collapse into relativism inherent in hard social constructivism. Critical realism is the view that a single reality exists, but that our access to it is limited by the scope and capacities of our tools of inquiry (Bhaskar, 2016; Elder-Vass, 2012; Moon and Blackman, 2014). It is therefore a philosophy of ontological realism and epistemological pluralism. Through critical realism, scrutiny of knowledge claims and the contingency and partiality of knowledge can be reconciled with an understanding of their being a singular physical world 'out there', as imagined by positivist science (Dryzek, 2013). Critical realists justify this realist ontology by posing the question, 'what must the world be like for scientific experiments to be possible and successful?'. Their answer is that, for replicable science experiments to be possible at all, there must be an underlying structuring reality that provides the consistency of results.

Where critical realists differ from positivists is in highlighting the work required to identify 'laws' of nature in repeatable experiments – that is, to make them observable to science. The significance of this is that reality itself is infinitely more complex than simple laws imply, and that we are not able to gain direct knowledge of this reality. Reality exists for the critical realist as a series of emergent levels, with each level exhibiting certain laws and dynamics that cannot be reduced to a lower level. Chemistry emerges from physics for example, but the known behaviour of chemical reagents cannot be explained purely through the laws of physics. Systems dynamics as explicated by complex systems theorists can be understood as a higher emergent level within the critical realist schema.

This structure of nested levels of emergence is what makes the design of experiments to capture specific laws of nature so difficult. These laws only exist at a certain level of emergence, and the experimenter must set up an artificial situation to isolate them from this context. This is also why many laws that are demonstrable

in a laboratory setting do not provide predictive capacity for phenomena in the 'real world'. Through experimentation it is possible to develop a predictive theory of what happens when you heat water, but it is much harder to predict the weather. For the critical realist, capturing the full complexity of interacting forces, dynamics and emergent layers of reality is impossible. We are restricted to identifying contingent patterns and regularities and to partial representations of the world through simplified models and constellations of analytical categories. There may be an underlying reality, but our access to it is only ever partial and contingent.

In attempting to capture the complexity of 'real life' we invariably fall back on simplified schema, models, constructs, and signifiers that are culturally and historically specific and thus normatively loaded. It is this insight that allows the critical realist to revisit, and cast doubt upon, positivist claims to objectivity. This realisation forces us to do three things. First, to be epistemologically pluralistic and to not, de facto, privilege the claims of Western science. Second, as social constructivists do, to attend more explicitly to the process by which knowledge claims are created and legitimised. Finally, to acknowledge the normativity of the mental constructs that any knowledge tradition adopts to make sense of the world. Each of these is relevant to the study of ES. Acknowledging the need for epistemological pluralism requires designing assessment and research techniques that are capable of combining and validating a variety of knowledge types. This in turn means that the standards of knowledge legitimation of Western science may not be appropriate and that alternative approaches to knowledge validation may be required. Finally, as has already been discussed, the ES concept should not be seen as a neutral framing and its specifically cultural and historical routes must be acknowledged.

2.2 THEORETICAL GROUNDING – ECOLOGICAL ECONOMICS

In Section 2.1 I have set out the ontological and epistemological position that informs this thesis. Theoretically, the thesis draws heavily from the meta-discipline of ecological economics. As discussed in Section 1.4, many of the critiques raised against the ES concept are specific to its treatment within the framework of neoclassical economics. The notion that valuing nature and putting a price on nature are synonymous only makes sense from a neoclassical perspective. Similarly concerns about commodification are only logical within a framework that gives primacy to the institutional form of the market. Ecological economics defines itself in

opposition to neoclassically-based environmental economics, making it an appropriate framework to develop an approach to the ES concept that avoids the pitfalls of reductionism (Costanza, 1989). Below I outline three strands of ecological economic thought that I draw upon in the thesis and that shape my thinking about the concept.

2.2.1 Environment-economy relationship

Whereas environmental economics defines the environment as a stock of resources to be integrated into the economic system, ecological economics defines the economy is a subsystem of the biosphere (Costanza and Daly, 2003). The implication is that economic activity is thus limited by the supply of resources and easily available energy, and the capacity of the biosphere to assimilate waste. This conceptualisation of the economy-environment relationship sits at the heart of ecological economics and structures its understanding of all economic processes.

2.2.2 Institutions matter – and it is not all about markets

Neoclassical economics is grounded in methodological individualism. Institutions set the rules of the game within which individual agents operate, but do not in any way structure the preference or beliefs of the agent. This concept of institutions as entirely external to the agent is the basis of New Institutional Economics – a school that grew out of neoclassical economics (Vatn, 2006). Ecological economics conceptualises institutions in a way more akin to classical institutional economics (Vatn, 2017). It sees individuals as embedded within institutions rather than separate from them, and understands these institutions to shape individual values, norms, and preferences.

The departure from methodological individualism undermines the micro-foundations of neoclassical economics. Without these micro-foundations it is not possible to support the primacy neoclassical economics ascribes the market as an institutional form. If this is rejected, as in ecological economics, there is no inherent reason for the ES concept to imply commodification or market exchange. From this perspective the drive towards commodification, in as much as this does happen, can be seen as coming from the norms and values of a specific context, rather than from the ES concept itself (Barton et al., 2017; Kull et al., 2015; Robinson et al., 2016).

2.2.3 Value theory

The final element of neoclassical theory that is refuted in ecological economics is the marginal utility theory of value as described in Section 1.4.1 above. Ecological economics puts forward a pluralistic understanding of values that recognises their potential incommensurability. Ecological economic work on value theory is discussed in Chapter 3 and in detail in Chapter 6.

2.3 BACKGROUND, MOTIVATION AND POSITIONALITY

It is a central contention of the thesis that it is not possible to reconcile the different views and interpretations of the ES concept. This fact is both a potential benefit, allowing the concept to operate as a boundary object, but also opens the door to reductionist interpretations and dangers of commodification. Another implication is that understandings of the concept are shaped by the norms and institutions of a given context. It is therefore necessary to reflect on my own positionality, and the context in which my thinking about the ES concept developed. In Sections 2.1 and 2.2 above I have detailed the philosophical and theoretical position from which I am writing. Below I recount the origin of this thesis by way of reflecting on how this has further shaped my own position as a researcher.

The thesis seeks to understand and guide the operationalisation of the ES concept in a way that reflects the complexity of the human-nature relationship. This is not where the project started. The PhD was originally intended to assess the ES produced by a marine protected area (MPA) around the Isle of Arran in the Firth of Clyde, Scotland. My intention was to build a Bayesian belief model to study how the MPA impacted on the flow of ES over time (Landuyt et al., 2013; Schmitt and Brugere, 2013). Not entirely by design, I diverted from this initial plan. I will lay out the factors contributing to my shift in focus, including how they shaped the overall flow of the thesis and the arguments that I develop.

My change in focus was driven by push and pull factors. As I developed ideas for a methodological approach to the study, several things troubled me. First, the spatial scale of the MPA, and the limited management measures, made it doubtful that significant biophysical change would occur as a result of the designation. Second, it seemed more suitable to think of the MPA as part of the wider Clyde sea area. The issue of delineating the impact of the site on ES from activities going on in the wider sea area appeared problematic. Third, it became apparent that the methodologies

needed would require a significant input of time and effort from various stakeholder groups. This was problematic, both because I was unsure how the results would be used, and therefore whether this effort would be justified, and because of tensions between different stakeholder groups in the area.

Around the Isle of Arran there are two MPAs: a small no-take area in Lamlash Bay designated in 2008, and a larger Nature Conservation MPA around the south of the island designated in 2014. The Lamlash Bay area was designated after more than a decade of concerted lobbying from COAST, a local conservation group based on the Isle of Arran (Stewart et al., 2020). Although local fishers were not entirely happy with the closure in Lamlash, they were engaged in the process and accepted the outcome, in part because of the small size of the closed area. By contrast, during consultations over the larger Nature Conservation MPA, relations between local fishers and groups campaigning for the designation in south Arran were strained and eventually broke down.

Within a day of my first visit to Arran in 2015, I was confronted by a fisher online to ask why I had immediately gone to COAST and not spoken to local fishers. I clarified that I would be very happy to meet for a discussion, to which I received no response. It soon became apparent that there was significant hostility between the two groups and that trust had broken down between then through the MPA designation process. This was exacerbated by the fact that all the mobile gear fishers are based in ports surrounding the Clyde on the mainland, and not on the island itself. Environmental conflicts of this type are nothing extraordinary, but as a newcomer to a situation with a complex history, I did not feel well positioned to develop a research methodology requiring engagement with groups on both sides of the divide.

These issues drove me to both think at a wider scale, and to think more carefully about how my work in the area could be integrated into ongoing policy changes. At the time I started this work, the Clyde Marine Planning Partnership (CMPP) had recently formed with the mandate to develop a marine plan for the Clyde sea region. I met with the CMPP and began to develop plans to undertake an ES assessment at the scale of the Clyde sea to contribute towards the development of the Clyde marine plan. I felt this was a more appropriate scale to consider ES, afforded me a more neutral position from which to engage with different groups, and was more likely to produce outputs of practical use. This work was eventually subsumed into a

bid for a competitive tender through SAMS to deliver a public dialogue for the CMPP. This public dialogue utilised research already undertaken by the CMPP, including on ES, and appraised different policy approaches to marine planning. The contract was delivered in partnership with an environmental consultancy and I worked as part of a team to design and deliver a series of workshops in 2017 (Phillips et al., 2018). Although this work has not been included in my thesis, this process has guided my thinking about the ES concept in a number of ways.

First, it made me attentive to the action-oriented nature of ES research. The study of ES does not fit into the realm of pure science. Undertaking an ES assessment automatically begs the question of 'so what'. Purely academic ES assessments can have value for the development or methodologies, or as demonstrator projects. Nonetheless, my experience left me with a view that ES assessments are best done as part of a policy process, with a specific objective in mind.

Second, it made me question the applicability of the concept to different governance contexts. The original purpose of the research was to look at ES delivered by a specific MPA. As I thought this through, I questioned whether it would, in practice, be possible to designate an MPA based purely on ES considerations. Such a move would overturn a significant history of designating MPAs on a features-based approach. Marine planning appeared a more suitable venue for the ES concept, yet the CMPP had only been successful in using the concept in a superficial manner. I was interested in what had driven them to attempt to use it, and why there did not appear to be an enabling policy framework.

Third, it brought into sharp focus the inherently political nature of environmental decision making. On paper, the ES concept in its most common form carries with it an air of rational calculus that I was not sure would hold in practice. I contemplated how an ES assessment of the MPA might be used by different interest groups to bolster their views. Indeed, COAST expressed concern about the study in case it did not support their position. They were not supportive of my desire to engage with the fishers off the island in the assessment. This made me question the potential limits of the concept to fundamentally change environmental decision making, which is so often driven by power dynamics between parties.

These observations and concerns shaped how the ideas and projects within this thesis developed. In parallel, I was presented with a number of opportunities to work on collaborative research project examining the ES concept, in particular, Chapter 3

and the case study in Box 1. Chapter 3 came out of such collaborations. Through these factors I re-oriented my research to focus explicitly on the role of the ES concept as the science-policy interface, using my knowledge and experience of Scottish inshore governance to test and explore the issues being raised by my conceptual work.

3 NAVIGATING PLURALISM: UNDERSTANDING PERSPECTIVES OF THE ECOSYSTEM SERVICES CONCEPT

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FOREWORD

Origin of chapter

This paper was conceived initially around the 2016 European Ecosystem Services Conference (EESC) in Antwerp. This conference brought together participants from three major EU projects seeking to operationalise the ES concept (OpenNESS, OPERAS and ECOPLAN). Organisers of the conference wished to develop a 'Declaration' on the future of the ES concept. The perceived need for such a Declaration stemmed from concerns that the ES concept was wrongly seen as 'placing a price on nature'. This Declaration was intended as a statement of intent for the future development of the concept, drawing on the knowledge and experience of the assembled researchers and policy makers.

I was not involved in the initial survey design and did not attend the Conference in Antwerp. The data collection and initial analysis was primarily conducted by study co-author Aster De Vries Lentsch. Following the conference, originators of the Antwerp Declaration wished to publish an adapted version as a journal article. Due to my research interest in the use of the ES concept, I was asked to assist in the preparation of the manuscript.

The initial manuscript was rejected, and it became apparent that additional analysis would be required to secure publication. I worked alongside Ms De Vries Lentsch to reanalyse the initial data and prepare a new manuscript for submission. This work included synthesising findings into the five cross-cutting themes in Section 3.3.2. Through the review process Ms De Vries Lentsch chose to step back from the project and I led a substantial rewrite of the paper. The introduction and discussion

are entirely my own work and I was assisted in responding to reviewers' comments on the methods and results section by co-author Dr Marc Metzger.

Working closely on this paper resulted in my developing a number of ideas and themes that helped to shape the remainder of my project. These were:

1- The conceptualisation of the ES concept as a boundary object
2- The potential for divergent understandings of the concept to hamper operationalise
3- The importance of the processes of institutionalisation in influencing how the ES concept is defined and operationalised

Thesis questions this chapter addresses

Q1. What principles should guide the operationalisation of the ES concept?

3.1 INTRODUCTION

3.1.1 A broadly operational concept despite a lack of unity

A number of wide scale assessments have taken place to assess the status and trends of the world's ES – including the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, 2005), The Economics of Ecosystems and Biodiversity (TEEB, 2010), and the assessments of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2018a, 2018b, 2018c, 2018d). Advances have been made towards operationalizing the concept in practice (Beaumont et al., 2017; Dick et al., 2018; Jax et al., 2018), and the concept is starting to be integrated into both national and international policy (Bezák et al., 2017; Bouwma et al., 2018; Matzdorf and Meyer, 2014). Dick et al. (2018, p. 563) declared that the ES concept is 'broadly operational', despite on-going debates within the ES community regarding conceptual frameworks, assessment and valuation methodologies, and even core terminology (Braat, 2018; Costanza et al., 2017; Díaz et al., 2018; Fanny et al., 2014). This lack of conceptual and methodological unity has previously been identified as a concern (Nahlik et al., 2012), although Dick et al. (2018) suggest the concept appears to be compatible in practice with a range of approaches founded in different philosophical traditions.

3.1.2 The acceptance of plurality within the field of ecosystem services

Accepting that the ES concept is open to multiple interpretations is seen by some as a strength, as it allows it to operate as a 'boundary object' (Abson et al., 2014; Schröter et al., 2014; Schröter and Van Oudenhoven, 2016). Boundary objects are concepts that are amorphous enough to be adapted to different contexts and worldviews, but are robust enough to act as a channel of communication between these different positions (Star and Griesemer, 1989).

The idea of ES as a boundary object is well developed in the literature (Abson et al., 2014; Galler et al., 2016; Hermelingmeier and Nicholas, 2017; Jadhav et al., 2017; Kull et al., 2015; Schröter et al., 2014; Steger et al., 2018). Saarikoski et al. (2017) found the concept operated as a useful boundary object in some of the 22 European and Latin American case studies they assessed. From their case study in German environmental planning, Galler et al. (2016) conclude that the ES concept can act as an effective boundary object in the early stages of collaboration, but that its usefulness decreases over time. This decrease in usefulness was largely due to conflicting interpretations of how the concept should be used in specific management or policy decisions. Saarela and Rinne (2016) develop the idea that artefacts (scenarios, simulation models, indicators etc.) produced using the ES concept, rather than the concept itself, may act as boundary objects. These artefacts are still open to multiple interpretations but are not neutral objects, as they are tied to the social and institutional context, with their embedded power relations, in which they are made (Saarela and Rinne, 2016). This can limit their capacity to operate as boundary objects, as they are only able to connect actors with pre-existing shared cultural values and preferences (Turnhout, 2009).

These discussions reveal a tension in the role of the ES concept as a boundary object. On the one hand, it is most effective as a broad concept that can accommodate a large range of perspectives and worldviews. However, this function decreases in the context of specific policy and decision making. Undertaking ES assessments for policy appears to require the development of standardised classification systems, conceptual frameworks, and related methodologies. This process may lead to certain worldviews being crowded out, and others foregrounded. If ES assessments are to become a mainstream approach for evidencing environmental policy and decisions, then such standardised practices will become institutionalised, potentially curtailing debate over the value laden

choices taken to create them. This dynamic is referred to by Steger et al. (2018) as the creation of 'infrastructure'. Infrastructure are "the tools, work practices, terms, and technologies that become embedded in and support a community of practice" (Steger et al., 2018, p. 144). The tension between the ES concept as a broad, open boundary object and as an institutionalised concept with precise terminology and associated practices is a key theme of this chapter.

There is evidence that the concept of ES is beginning to enter into national policy and legislation, but not yet in a manner that includes the explicit use of ES assessments and valuations (Bezák et al., 2017; Bouwma et al., 2018; Kistenkas and Bouwma, 2018; Leone et al., 2016; McKinley et al., 2018). Within the research community, continued disunity can be seen in ongoing debates over core frameworks and terminology since the introduction of the concept of 'Nature's Contribution to People' (Braat, 2018; Díaz et al., 2018; Kenter, 2018; Maes et al., 2018; Pascual et al., 2017). Peterson et al. (2018) make the case here for an acceptance of pluralism to avoid a potentially harmful polarisation within the ES community. Hermelingmeier and Nicholas (2017) similarly embrace the range of perspectives that still exist around the ES concept, making the case for 'guided pluralism'.

The continued heterogeneity of interpretations and understandings of the ES concept requires an exploration of how far such a pluralistic outlook should be extended. Accepting pluralism does not mean that any work carried out either in research or policymaking using the language of ES is accepted as part of the overall canon, regardless of the theoretical basis, methodological approach, or normative framing. The term 'guided pluralism' used by Hermelingmeier and Nicholas (2017) captures this idea. This term originates from the attempt of Baumgärtner et al. (2008) to develop a framework for coping with the heterogeneous practices within the field of ecological economics. However the idea has not been explicitly developed in the ES literature. Hermelingmeier and Nicholas (2017) only suggest the need for open dialogue over values and assumptions to establish common ground for research.

Baumgärtner et al. (2008) seek to harmonise the epistemological and methodological diversity of their field that interweaves descriptive and positive science with values and normative judgement. In applying the concept of guided pluralism to the field of ES, we carry forward this differentiation of epistemological

and methodological diversity, and the view that this naturally arises from different philosophical and normative positions. We add the consideration of theoretical diversity, with theory being an intermediate stage, informed by particular epistemologies and informing methodologies. The second theme of this paper is an attempt to identify guiding principles with which to navigate this diversity, as to achieve a 'guided' pluralism within ES research and practice.

The two notions of boundary object and guided pluralism are complementary. Boundary objects accept pluralism, while the notion of guided pluralism allows space to discuss principles with which applications of the ES concept can be directed.

3.1.3 Aims

To analyse the work on the ES concept as a boundary object, and the applicability of the notion of guided pluralism, it is important to understand different views within the ES community. This study hence aims to understand the way the ES concept is viewed by researchers, policymakers, and practitioners. Firstly, we are interested in perceptions of strengths and weaknesses in the concept, and the different ways that people see the concept being used to inform decision making. From here we ask if the ES concept can be seen as a boundary object, and what the limitations are to this in the context of policy and decision making. Secondly, we seek to identify guiding principles for the ES concept, by synthesizing views from different user groups. Finally, this paper is also intended to underpin the Antwerp Declaration, which was developed during the conference hosted by the Ecosystem Services Partnership in Antwerp in 2016. The declaration is an attempt to account for the critiques and concerns viewed by participants and reflect a need and desire to further develop the ES concept.

3.2 METHODS

3.2.1 Survey design

We distributed a digital mixed methods survey among 350 early registrants to the EESC[3], which presented a good sampling pool for all three target groups: academics, including junior researchers, who seek to gain knowledge and understanding; policymakers, who develop and implement governance strategies

[3] www.esconference2016.eu

and instruments; and practitioners, who broadly spoken support policy development and/or make environmental management decisions. The conference – which attracted 700 delegates – was organised by three large research projects (OPERAs[4], OpenNESS[5], ECOPLAN[6]), the University of Antwerp, and the Ecosystem Services Partnership[7], one of the largest international networks focused on ES, and so brought together a wide range of people from across the field. We engaged with early registrants to be able to present and discuss the outcomes at the conference. The survey was distributed through the conference organisers' official e-mail list.

The survey was divided into four categories to capture different aspects of people's views of the ES concept: its underlying purpose (P)*;* visions (V) for its future evolution (named goals in the survey); perceived myths (M) that misrepresent the concept; and frustrations (F, named grumbles in the survey) to capture any irritations with the ES concept not captured in the other categories. Each category featured one closed question, and two or more open-ended questions, allowing participants to enter as little or as much text as they needed to express their ideas and opinions. Participants were asked to complete at least one category, and at the end of their first round of questions were given the opportunity to complete additional ones. Table 1 summarises the questions, which were phrased in generic terms to allow respondents the opportunity to give unrestricted open answers. The full questionnaire is included in **Appendix 1**.

[4] www.operas-project.eu
[5] www.openness-project.eu
[6] www.uantwerpen.be/en/research-groups/ecoplan/
[7] www.es-partnership.org

Table 1. Summary of the survey questions for the four survey categories: Purpose (P), Visions (V), Myths (M), Frustrations (F). One question on supposed differences of opinion (A1) was asked to all respondents at the end of the survey. The questions were either on a 5-point Likert scale (Likert), multiple-choice multiple answers (MCMA) or open-ended (open). MCMA statements are included in Fig. 2. The full survey is available as Appendix 1.. ID

ID	Question	Type
P1	The ecosystem services concept provides a utilitarian framing of ecosystem functions as services to increase public interest in conservation.	Likert
P2	The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of how human well-being in many ways depends on natural systems.	Likert
P3	Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels.	Likert
P4	Can you put down in your own words what you think is at the heart of the ecosystem services framework?	Open
P5	What would be the worst misuse of the ecosystem services framework?	Open
P6	Beyond basic research ethics and good practice, what values and principles or ideas should guide the practical applications of the ecosystem services framework?	Open
V1	In 20 years' time, what role should the ecosystem services framework have in society?	MCMA
V2	What are the main challenges for the widespread use of the ecosystem services framework?	Open
V3	What do you think are key steps to undertake in the future development of the ecosystem services framework?	Open
M1	Can you describe a common myth or misunderstanding you frequently encounter in your work?	Open
M2	Who holds these erroneous views?	Open
M3	What to your mind is the source of confusion that gave rise to these myths?	Open
M4	How would you debunk the myth?	Open
M5	Have you ever encountered one of the following claims regarding ecosystem services in your work?	MCMA
F1	What do you find most frustrating about working with the ecosystem services framework?	Open
F2	What would be the best way to resolve your frustration?	Open
F3	What to your mind is the biggest theoretical, moral, or practical shortcoming of the ecosystem services framework?	Open
F4	How could that shortcoming be remedied?	Open
F5	Have you ever encountered one of the following frustrations?	MCMA
A1	In the field of ecosystem services, where do you think the biggest differences of opinion lie?	Open

3.2.2 Quantitative analysis

Attributes, i.e. characteristics of participants or cases (Bazeley and Jackson, 2013), were included in the survey design as open questions to prevent restricting participants in their answers. Based on the qualitative entries we constructed attribute labels for gender, discipline, and years of experience (Table 2). For 'Field of Study' we captured unclear answers with the 'Other discipline' category. Participants were also asked whether they were an academic researcher, junior researcher or student, practitioner, policymaker or 'other'.

Each category of the survey (Purpose, Visions, Myths, and Frustrations) had one multiple-choice section for which we compiled separate bar charts to help identify themes and support for the qualitative analysis of the open questions.

Table 2. Retrofitted attribute labels describing survey participants

Open-ended	Retrofitted Attribute labels
Gender	Female, Male
Years of experience	<5; 5-9; 10-19; >20
Discipline	Natural/Physical Sciences, Social Sciences, Economics, Science Policy Nexus, Inter/Transdisciplinary, Other discipline

3.2.3 Qualitative analysis

A general inductive approach (Thomas, 2006) to thematic content analysis was used to examine patterns in the responses to the open survey questions (Table 2) in a replicable and systematic manner (Bryman, 2016). The general inductive approach provides an easily used and systematic set of procedures for analysing qualitative data that can produce reliable and valid analysis of underlying structure in the raw data (Thomas, 2006). Rather than making prior assumptions about the survey responses in a predefined coding frame, an inductive approach was followed because we had no comprehensive predetermined expectations of the patterns,

similar to Asah et al. (2014) and Maraja et al. (2016). The intended outcome of the inductive coding process was to create a small number of summary categories that in the evaluator's view capture key aspects of the themes identified in the raw data and are assessed to be the most important themes given the study's objectives (Thomas, 2006).

We followed the five stages of analysis described by Thomas (2006) using the NVivo qualitative data analysis software (QSR International, 2016). The full set of responses was read carefully (1) and specific text segments were identified that related to the topic of the survey category (2). These segments were labelled to create a set of initial themes (3), which were refined to reduce overlap and redundancy (4) in an iterative process both within the categories and across the whole survey, allowing responses to be coded for multiple themes. Themes that were rarely mentioned were grouped as 'other'. The final stage consisted of creating a model that incorporates the most important themes into a limited set (5). Thomas (2006) explains that inductive coding that results in too many major themes – he suggests more than eight – can be viewed as incomplete and encourages the evaluator to make hard decisions about which themes are most important.

Given likely overlap in responses between the different survey categories we anticipated that the final step would identify a number of cross-cutting themes. The choice of these cross-cutting themes was supported by the results of the quantitative analysis and looked for both consensus and divergence in views among the respondent categories. The cross-cutting themes are illustrated with quotes and cross-references were made to the survey questions that provided answers in support of the cross-cutting theme.

3.2.4 Corroborating our findings and building towards a unified message

Key findings from the analysis were presented at EESC 2016 to corroborate our findings through discussions with conference attendees, and to collaboratively shape a charter (named the Antwerp Declaration) that could capture and communicate a set of recommendations based on our findings and discussions. An early findings document was compiled and distributed among conference participants in the delegate packs. This formed the basis for informed discussions and events during the conference where participants could engage with the Antwerp Declaration process: a parallel session on the second day of the conference presenting and discussing many of the themes relevant to the Declaration; a Quote

of the Day booth where participants could vote and share their opinion on proposed bits of text for the Declaration; and a workshop held on the third day specifically addressing different aspects of the Declaration. Input gathered through these events was then taken forward by a writing team. At the end of the conference the final Declaration was presented in plenary and a website was opened for signing the Declaration.

3.3 RESULTS

3.3.1 Survey response and respondent attributes

The response rate was 34%, n=121, comprising academic researchers (50%); junior researchers (24%); practitioners (15%); policymakers (7%), and 4% who did not fit these categories. The gender balance was 41% male, 51% female, and 8% not stated, and most people reported their experience in the field of ES to be under or around 10 years.

Table 3 contains our interpretation of the participant categories. However, these definitions were not included in the original survey and we recognize that some individuals could fit in more than one category (e.g. a researcher in an NGO). This is especially true given the contemporary shift from ‘government’ to ‘governance’ and towards a post-normal science approach to research for policy making. We took responses to mean that respondents identified most with this group and saw this as their primary role. The category of ‘practitioner’ is also open to interpretation and this role may change depending on the way in which the ES concept is used. From the data collected we were not able to determine the precise role of individuals who identified as practitioners.

All participants were obliged to complete the questions for at least one category, and many chose to complete multiple (Figure 13). Participants were free to choose which category they completed, but the distribution among themes suggests most people followed the categories in order of listing (Figure 13), although this may also reflect their interests.

Table 3. Definitions of each participant category

Category	Definition
Academic researcher	Research staff at a University or research institute
Junior researcher	Researcher at an academic institution, either at PhD or post-doc stage
Practitioner	Individuals responsible for implementation or making environmental management decisions 'on the ground'. This can include support of the creation of public policy (civil service) or overseeing its implementation (government agencies or third sector)
Policymaker	Individuals working for national or supranational government with statutory responsibility for creating public policy
Other	Those that did not identify as any of these categories

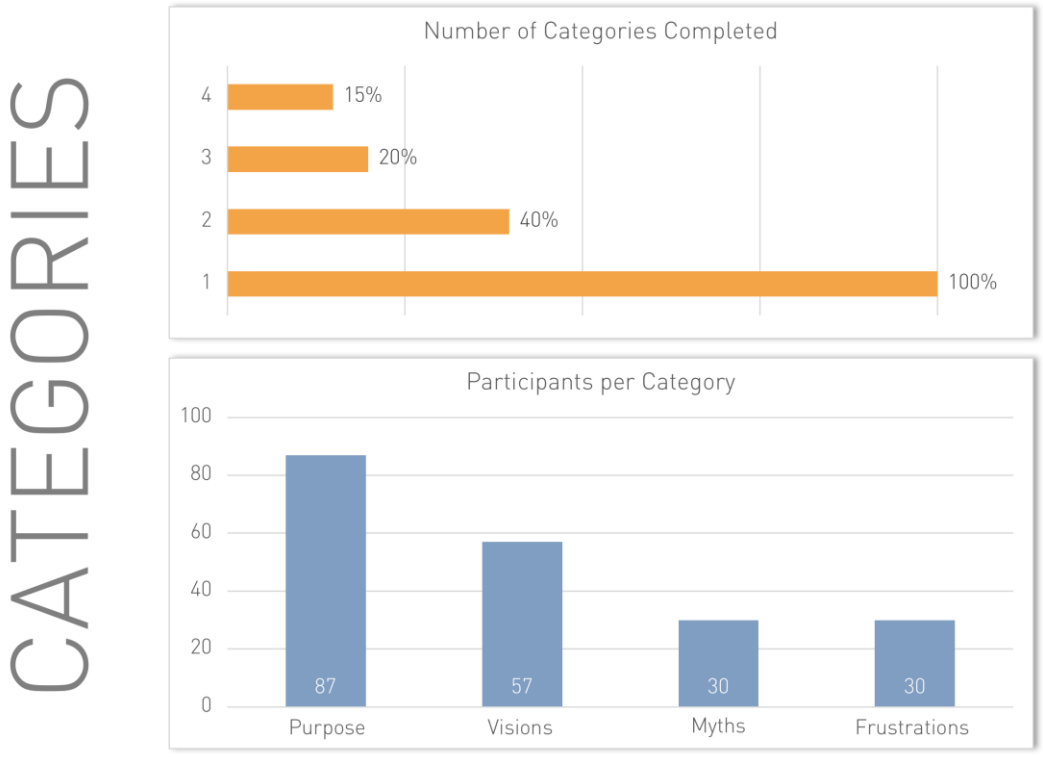

Figure 13. Number of survey categories completed by participants and number of respondents per category

Figure 14. Responses to the closed questions in the survey

3.3.2 Multiple choice responses

Figure 14 presents an overview of the Likert scale and multiple-choice responses for questions P1, P2, P3, V1, M5 and F5. There was strong agreement that the ES concept could increase societal interest in conservation (P1) and raise awareness of human reliance on natural systems (P2), but opinion was divided as to whether an economic approach could support better decision making (P3). There was a shared vision that the ES concept would achieve a paradigm shift in environmental protection (V1C). Three myths frequently encountered were that the ES concept: does not consider the intrinsic values of nature (M5B); is a capitalist paradigm about making money (M5A); and implicitly accepts that human benefits are the only things that should be protected (M5D). The most dominant frustrations with the ES concept were: challenges to communicating non-economic research due to misconceptions that economic valuation is at the core of the concept (F5C); that it has become such a buzzword that the concept becomes increasingly vague (F5E); and that the terminology is too complicated and academic to use with non-expert audiences (F5A).

3.3.3 Cross-cutting themes

Thematic content analysis helped structure the richness of the open question responses. **Appendix 2** provides an overview of the identified themes per question. Identical or highly related themes emerged for different questions and different survey categories. Results were therefore further synthesised to five cross-cutting themes, which are described below. The descriptions are based on the open-ended survey responses and identified themes, which are referenced, and illustrated by direct quotes.

3.3.3.1 Cross-cutting theme 1: Purpose of the concept

The core purpose of the ES concept was viewed by most respondents as an 'awareness raising' metaphor of the many ways human well-being depends on natural systems. This was evident in responses to P1 and P2 (Figure 14) and confirmed by the open-ended answers to P4. This can be exemplified by this quote: "The ecosystem service framework is useful to quantify the multifunctionality of ecosystems and to demonstrate how human health and wellbeing depend on the multiple functions and services of ecosystems. It is a concept that can be used to increase awareness among ecosystem users and to support conservation" (Academic Researcher response to P4).

Three primary themes emerged from responses to P4 regarding what respondents felt to be at the heart of the ES concept, ‘awareness raising’, ‘scientific approach’, and ‘decision making aid’. ‘Awareness raising’ was the most common theme, particularly amongst academics (see Table. 4). The ‘decision making aid’ code captured answers that emphasised how the ES concept supports natural resource management and allocation, or explicitly referred to decision making. Entries coded as ‘scientific approach’ highlighted the ES concept as a cognitive exercise, aimed at better understanding of socio-ecological systems. ‘Decision making aid’ and ‘scientific approach’ appeared a similar number of times. Four more codes for P4 were derived for responses that combined elements of the three main codes (see Table 4).

Table 4. Summary of the responses under the ‘Purpose’ theme of the survey

Theme	*Summary of responses coded under theme*	Academic Researcher	Student/Junior Researcher	Practitioner	Policy maker	Other	Total
Purpose (Values)							
P4 - Can you put down in your own words what you think is at the heart of the ecosystem services framework?							
Decision-making aid	*ES as tool/support for decisionmaking & resource management*	7	1	2	1	1	**12**
Scientific approach	*ES as a scientific endeavour, expanding knowledge*	4	2	3	1	0	**10**
Awareness raising	*ES to demonstrate value of nature*	22	11	4	0	1	**38**
Holistic approach	*ES as an encompassing approach to complexity*	3	3	0	1	1	**8**
Advocacy x Science	*Responses combining science and awareness raising, focus on general public*	8	4	1	2	0	**15**
Decision x Activism	*Responses combining awareness raising and decision support, focus on policy*	4	4	0	2	1	**11**
Science x Decision	*Responses combining science and decision support, technocratic focus*	2	0	4	1	0	**7**
Other		4	1	1	0	0	**6**

3.3.3.2 Cross-cutting theme 2: Concerns with the use of economic valuation

Although frequently mentioned and occasionally criticised (V2, V3), economic valuation was – overall – not perceived to be inherently problematic, but its potential misuse was a concern for many. Respondents disagreed whether an economic approach would help decision making (Figure 14; P3). Participants were concerned that misuse of the ES concept could lead to poor decision making, rushed and under-resourced assessments used to further a political agenda, and a bias towards industry interests (P5, V2). Several respondents warned against considering the ES

concept as a panacea or cure-all for any environmental or resource management challenge regardless of the appropriate scale, methods, and application of the framework (V2). There were also concerns about the framework potentially backfiring by providing a rationale for environmental degradation rather than conservation (P5) as illustrated by the following quote: “The misconception that it is all about utilitarian and monetary values. This is untrue, even to the contrary. However, this has been repeated so often, and some instances in fact do misuse the concept that way still. Kind of a self-fulfilled myth almost” (Academic Researcher response to M1).

Thematic content analysis revealed that these frustrations stem from a polarised academic debate, and to a lesser extent from opposition with conservationists. This polarisation and confusion is potentially stirred up by media and high-profile publications that are feeding the debate on which dominant worldviews and ideologies are being served by the ES concept. Meanwhile, new ES terminology and underlying conceptual frameworks are continuously developed, with different ideas about the role of economic valuation (M3). There was considerable frustration about false perceptions that economic valuation is central to the ES concept, which was expressed exhaustively as a common misunderstanding (M1), but also as a frustration (F1) as illustrated by the following quote: “That ecosystem services is all about 'valuing nature' - it's an approach that should be used very intelligently to frame environmental management challenges through a more socially relevant and integrated lens. Valuation is just one tool in the ecosystem services basket” (Policymaker response to M1).

3.3.3.3 Cross-cutting theme 3: The importance of understanding social and cultural values in policy and decision making

Although economic valuation was not seen as problematic – as explained above – many respondents were concerned about the lack of non-economic valuation methods (V2), and the more limited interest and ability to include non-economic valuation in decision making (V2). This bias can lead to poor decision making (P5), and the explicit incorporation of social and cultural values into decision making was expressed as an important step in the future development of the ES concept (V3). This would prevent misuse of the framework (P5) and help overcome a range of shortcomings currently identified (F3) –including a lack of social science compared to ecological and environmental sciences and economics. Embracing social and

cultural values was seen as important communication pathway to both wider society and decision makers (V3, F2, F4), countering potential misunderstandings and inappropriate use of monetary definitions of value (M4), and a key requirement to realizing the transformative potential of the framework (V3, F4). The following quote is one of many emphasising the importance of social and cultural values:
"Incorporate the cultural (and spiritual) value of nature more which brings back the connection to nature and why we care about nature" (Junior researcher or student in response to V3).

3.3.3.4 Cross-cutting theme 4: The need to further expand inter- and transdisciplinary approaches to ecosystem services assessments

Many respondents hope the ES concept would be considered a paradigm shift in environmental protection within the next 20 years (35% or responses; V1C Figure 14). Despite this apparent enthusiasm, a broad range of challenges impeding the widespread use of the ES concept were raised (V2) including: the lack of training and awareness of the concept among policymakers and practitioners; a lack of demonstrable policy impact and evidence of halting environmental degradation; institutional barriers and 'silos' in research and governmental bodies; and the technocratic and/or utilitarian terminology. These challenges were mirrored in frustrations about the bias and limitations in methods and decision-making processes (F3).

There was recognition that the ES concept has been a catalyst for promoting collaboration across disciplines (P4), but that expanding collaboration further is essential to stimulate dialogue and generate common understanding that is necessary to achieve societal impact (V3, F4). Framing the challenges around issue-based research will encourage transdisciplinary collaboration between disciplinary experts, business stakeholders and public body representatives (V3, F4). The involvement of knowledge brokers and the media is critical in supporting collaboration and in communicating outcomes (F4). The following quote is one of many calling for interdisciplinary research: "Ultimately, it is critical for a more interdisciplinary approach to the scientific research agenda to enrich the research and facilitate better policy translation and a reduction in the emergence of perverse policies" (Respondent from 'other' category in response to V2).

3.3.3.5 Cross-cutting theme 5: Ecosystem services in policy and decision making

As identified above the ES concept can assume different roles in decision or policy making contexts. It may be used directly as a 'decision making aid' through the instrumental mode of knowledge use (Mckenzie et al., 2014; Weiss, 1979) or as an 'awareness raising' tool akin to the conceptual mode of knowledge use (Dunlop, 2014; Weiss, 1979). Although less directly related to policy and decision making, using the ES concept in the context of a purely 'scientific approach' may also influence decisions again through the conceptual mode by contributing to societies wider understanding of the dependence of humans on natural systems.

A number of ways to increase the uptake of ES in policy and decision making were identified that span both instrumental and conceptual knowledge use. A clear need for practical learning emerged (V2, F1, F3, F4), and case study research was identified as a way to progress the implementation of the framework to support land management decision making (V3, F4). To this end, several steps for further development of the ES concept were identified (V3, F4): develop and share targeted information, packaged and communicated appropriately to selected audiences; engage stakeholders and the public; and include more socio-cultural values and closer work with social scientists.

There were many frustrations related to the user-friendliness of the ES concept (F1, F2) as a decision-making aid. Irritations about the academic nature or the terminology (F5A, Figure 14), has already been mentioned, but the content analysis revealed frustration around the lack of standardisation (F2), insufficient suitable and accessible methods (F3), and a lack of data (V2, F3). Those identifying primarily as practitioners also signalled being overwhelmed by the variety of categorisations and tools available, and the background information required for their appropriate application (F3); suggesting these may have been policy practitioners. The following quotes illustrate the frustration with the user-friendliness of the ES framework: "The language – and therefore the concept – suffers from its technocratic, utilitarian image" (Academic researcher in response to V2); "It is frustrating how many parties seem obsessed with re-classifying ES on a continual basis - this is often unnecessary and unhelpful when seeking to implement a joined-up approach across different interest groups" (Policymaker response to F1).

The Antwerp Declaration

Following a decade of ever more research activity the ecosystem services framework has major political and scientific momentum. We must now deliver societal impact.

In this declaration we – the signatories – call for action to realise the transformative potential of the ecosystem services framework. We need to refocus on principles of sustainability, reclaim the notion of value and expand collaborations.

Refocus on principles of sustainability

Ecosystem services gained prominence as a framework that acknowledges nature's fundamental role in supporting human wellbeing. There has been considerable progress in quantifying, valuing, and mapping ecosystem services. Yet, there is a risk that these methods are applied without consideration of equality and social justice. To ensure the fair distribution of nature's benefits we need to refocus the ecosystem services framework on the principles of sustainability. By explicitly including sustainability principles in ecosystem services assessments we can bring into focus trade-offs between conflicting interests, guide just decisions and avoid misuse of the concept.

Reclaim the notion of value

How we understand our relationship with nature sits at the heart of the ecosystem services framework. To do justice to all the ways nature matters to us as humans we need to include diverse values into our assessments. By embracing a multitude of perspectives, voices and values we can move away from understanding nature's importance in a purely monetary way. Finding innovative approaches that include multiple values is challenging, but enables us to make better decisions. Collaborative projects with many different stakeholders should therefore be the starting point of any ecosystem assessment.

Expand collaborations

The ecosystem services framework has been a catalyst for promoting collaboration across disciplinary boundaries. Expanding collaboration is essential to stimulate dialogue and generate common understanding that is necessary to achieve societal impact. Framing the challenges around issue-based research will encourage collaboration between disciplinary experts, business stakeholders and local government representatives. The involvement of knowledge brokers and the media is critical in supporting collaboration and in communicating outcomes.

For impact we need to

- make the most of the large amount of knowledge and learning that is generated by case study research
- develop and share targeted information, packaged and communicated appropriately to selected audiences
- increase the user-friendliness of frameworks and tools to support their application beyond current users
- bring business and researchers together to encourage innovation and creation of new flexible business models that integrate ecosystem services
- strengthen the integration of ecosystem services into all policy sectors in dialogue with researchers and practitioners

Sign the Declaration today:
www.antwerpdeclaration.com

Figure 15. The Antwerp Declaration

3.3.4 The Antwerp Declaration

The 'early findings' document, included in the EESC delegate pack (see **Appendix 3**), formed the basis for the participatory exercises during the conference, which received input from approximately 100 individuals. These participatory events largely confirmed the cross-cutting themes summarised in section 3.3, although greater emphasis was placed on the importance to focus the ES concept on the principles of sustainability. The discussion also provided guidance about how to translate the findings to a short Declaration that forms a call for action that was signed (on a voluntary basis) by the conference delegates. The resulting Declaration (Figure 15) was presented at the closing plenary and has been signed by 331 people on the website www.antwerpdeclaration.com following the conference (last count 17 August 2018).

3.4 DISCUSSION

The EESC represented a rare opportunity to collect the views of a varied group of researchers, practitioners and policymakers engaged with the ES concept. We recognise our result reflects a primarily Eurocentric perspective. However, the survey received many responses and the events held at the conference were well attended, allowing us to collect insights from a diverse group.

3.4.1 The role of the ecosystem services concept in the science-policy interface

Responses to our survey demonstrate the tension between the different roles that the ES concept can play at the science-policy interface. Many participants expressed the view that the concept was a useful awareness raising tool and could be used to integrate different perspectives and approaches in environmental management (Cross-cutting theme 1). That is, to function as a boundary object. Many academics in our study did not identify scientific inquiry as the primary role of the ES concept, instead emphasising the awareness raising role that it plays. This could indicate a perception among academics of the ES concept as a way to communicate research findings to a broader audience, rather than as a tool for scientific inquiry (Barnaud and Antona, 2014; Crouzat et al., 2017).

There were also concerns around the lack of standardisation and the user-friendliness of the concept for decision makers (Cross-cutting theme 5). Indeed,

many practitioners and policymakers did not see the core purpose of the ES concept as contributing directly to decision making at present (Table 4). This is consistent with recent literature suggesting that, despite a number of projects and toolkits aimed at integrating the ES concept into decision making, assessments rarely play an instrumental role in influencing decisions (Dick et al., 2018; Martinez-Harms et al., 2015; Ruckelshaus et al., 2013; Saarikoski et al., 2018).

Standardisation was the most frequently cited remediation for the issue of user-friendliness, amongst all groups (F2). Efforts are being made to standardise the categorisation of ES (primarily through the Common International Classification of Ecosystem Services (CICES[8])), and several calls and attempts to standardise conceptual frameworks and assessment/valuation approaches have appeared in the literature (Boerema et al., 2017; Boyd and Banzhaf, 2007; Seppelt et al., 2012, 2011). However, standardisation involves the curtailment of some of the conceptual and methodological diversity that exists within the ES community. This could potentially hamper inter- and transdisciplinary dialogue and communication supported by our respondents (Cross-cutting theme 4). Standardisation correlates to the creation of 'infrastructure', and we follow Steger et al. (2018) in suggesting that such a move would limit the capacity of the ES concept to function as boundary objects. This supports the conclusion of Galler et al. (2016) that the ES concept may function most effectively as a boundary object prior to the point where it is used to inform specific policy or management decisions.

This does not imply that the concept plays no role in policymaking; others have identified conceptual learning, consistent with the boundary role of ES, as a promising impact pathway of ES assessments and research (Beaumont et al., 2017; Carmen et al., 2018; Dick et al., 2018; Ruckelshaus et al., 2013).

There is then a potential conflict between those who see the ES concept as a tool for raising awareness and discussion, and those who wish to see it standardised and used in decision making. We argue that this can be reconciled by accepting that the concept is capable of playing both roles at once. Whilst the creation of standardised infrastructure should be supported, it is also necessary to maintain a more pluralistic notion of the concept within academic and policy debates (Figure 16).

[8] www.cices.eu

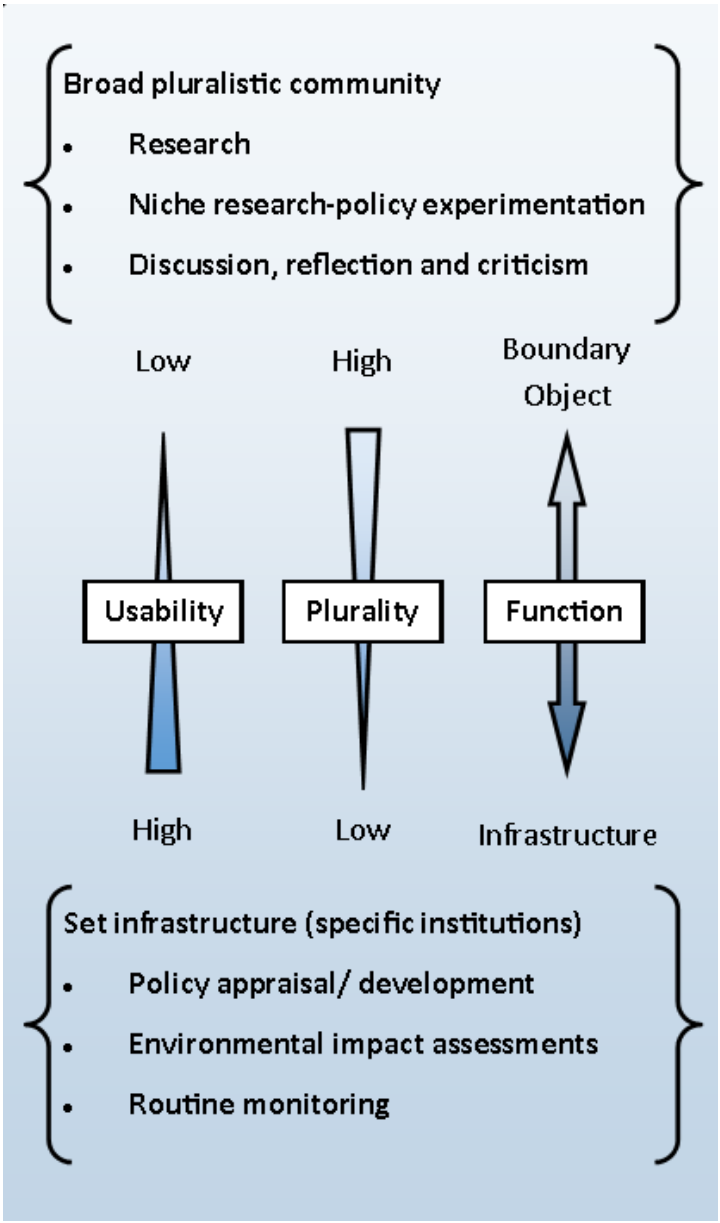

Figure 16. Trade-offs between the function of ecosystem services as a boundary object and as set infrastructure capable of informing policy and decision making, in terms of usability and plurality

The creation of infrastructure will reflect and embody the norms of the context in which it is developed (Saarela and Rinne, 2016; Turnhout, 2009). This can be a necessary trade-off to improve usability and uptake of the concept directly in decision and policymaking. However, it can become problematic for two reasons: 1) if the knowledge, views or values of a particular group or groups within this context are excluded, for instance, the development of accounting schemes for ES might focus on instrumental values (Hein et al., 2015), and could be problematic for the

inclusion of relational values that people might hold with respect to nature (Pascual et al., 2017). Or 2) if such infrastructure is transplanted to a cultural context that is significantly different from where it was created (as may be the case in transnational environmental governance settings). This problem was recently pointed out by Díaz et al. (2018), emphasising the need for context-specific perspectives when assessing the relations between humans and nature. Polasky et al. (2015) similarly make the point that ES assessment standards should be tailored to specific use contexts.

Experimentation with the ES concept in different policy contexts is increasing, and it is possible that we will see a continued construction of infrastructure within different administrative jurisdictions (at a sub-national, national, and international scale) (Bezák et al., 2017; Bouwma et al., 2018; Mauerhofer, 2018; Mauerhofer and Laza, 2018a; McKinley et al., 2018). As this happens, retaining a highly pluralistic notion of the concept that exists above any contextually specific infrastructure has two distinct advantages over full standardisation. Firstly, it maintains space for worldviews that are excluded through the construction of infrastructure, allowing the ES concept to still function as a boundary object that enhance debate and awareness raising over the relationship between nature and human well-being. Secondly, it allows space for more critical, dissenting voices and academic disciplines to highlight constantly the way that the creation of infrastructure can obfuscate and normalise political choices made during its creation. Critical geographers, for instance, are well positioned to offer such critique, as their discipline is well versed in exploring the power relations around the social construction and mobilisation of emerging and ‘taken for granted’ concepts and practices (Kull et al., 2015; Turnhout et al., 2016).

3.4.2 Valuation of ecosystem services: integrating cultural and social values as a guiding principle

Values, and valuation, are useful vehicles to explore the dynamic between the ES concept in the broad, pluralistic sense (where it is most effective as a boundary object), and the concept as set infrastructure. Our results show a clear desire for social and cultural values to be better captured in ES assessments (Cross-cutting theme 3). This was reaffirmed through input to the Antwerp Declaration, where the need to ‘reclaim’ the notion of value was raised. This desire resulted from the dual perception that 1) integrating a plurality of values is essential to ensure that ES

assessments lead to inclusive decision making, and 2) a perception exists that only a limited definition of value is captured within the ES concept.

The concept of ES has stimulated much debate about the notion of value, and how best to measure it; bringing together scholars from a wide range of disciplines (Chan et al., 2012b, 2016; Edwards et al., 2016; Fanny et al., 2014; Fish et al., 2016b; Jacobs et al., 2016, 2018; Jax et al., 2013; Kenter et al., 2015, 2016d; Ranger et al., 2016; Sagoff, 2011). Here we see ES work as an effective boundary object, and many methodologies now exist for integrating different types of values into ES assessments (Iniesta-Arandia et al., 2014; Jacobs et al., 2016; Kenter, 2016a; Kenter et al., 2016d, 2016b; Ranger et al., 2016). Such methodologies are now established as a part of the plethora of existing ES approaches and practices. Operationalizing these methods in real world decision making was a core priority that emerged from our survey (Cross-cutting theme 3).

However, no method is capable of capturing all types of value (Jacobs et al., 2018), and it is not necessarily the case that the use of a variety of methods will become standard practice within policy and decision making. In the UK for example, the importance of shared and cultural values was recognised in the UK NEA (UK NEA, 2014). However, the Treasury 'Green Book' which dictates valuation methods for public body decision making in the UK relies exclusively on methods derived from neoclassical economics (Treasury, 2011). The centrality of marginal utility value theory in neoclassical economics makes it difficult to meaningfully account for shared and cultural values. As the ES concept becomes embedded in set infrastructure there is a risk that evaluation methods will foreground incumbent individualist notions of value at the expense of methods accommodating of social and cultural values.

Narrow economic valuation of ES was criticised by some respondents to our survey but was largely not seen as inherently problematic (Cross-cutting theme 2); matching findings from previous studies (Fisher and Brown, 2015; Hermelingmeier and Nicholas, 2017). Concerns were raised however regarding the potential for ES studies to be misused to further specific political agendas or support environmentally destructive activities. This may be the case if infrastructure is created in the context of highly extraction-driven, capitalistic norms. Maintaining a pluralistic notion of the ES concept will ensure that space remains for critical reflection on assessment and valuation approaches within different institutional settings. Within this context, the

desire to ensure that social and cultural values are captured offers a potential guiding principle for the ES community.

3.4.3 Expanding inter- and transdisciplinary approaches

Increased collaboration, both between academic disciplines and between academia and wider society, was identified as a key area for the development of ES research and practice. The expansion of inter- and transdisciplinary work was a clear desire of the respondents (Cross-cutting theme 4) and matches aspirations in the literature (Carmen et al., 2018; Jacobs et al., 2015). The inclusion of more social scientists within ES assessments was particularly stressed as a necessary step to increase the integration of social and cultural values (Cross-cutting theme 5).

The ES concept arose at the interface of ecological and economic science, however is now engaged with by, and functions as a boundary object between, a large range of disciplines (Chaudhary et al., 2015). Yet physical, economic and social geographers are just a few groups to have been identified as having useful, but underutilised insights (Barnaud and Antona, 2014; Dempsey and Robertson, 2012; Potschin and Haines-Young, 2011). Even large scale efforts at interdisciplinary working, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), are to some degree dominated by natural scientists (Timpte et al., 2018) and within IPBES the need for a stronger engagement of social science and humanities was particularly emphasised (Díaz et al., 2018).

Our results suggest the lack of engagement from some disciplines may be due to the way the concept is perceived. Although respondents to our survey did not see economic valuation as central to the ES concept (P4), the perception that the two are closely interlinked was commonly encountered by participants. This view was encountered primarily from other scientists and, to a lesser extent, conservationists (Cross-cutting theme 2). One respondent suggested that many groups and scientists simply refuse to engage with the ES concept (P2) due to its image as a technocratic and utilitarian approach. This finding matches others who have noted the tendency to conflate ‘ecosystem services’ with ‘payments for ecosystem services’ (PES) schemes, and the potential for such confusion to deter some from engaging with the concept (Schröter et al., 2014; Schröter and Van Oudenhoven, 2016).

The perception that the concept of ES is equivalent to putting a price on nature limits its capacity to function as a boundary object. Increasing integration of other disciplines into ES research may be assisted by improving communication to overcome myths about the concept (see section 5.1.3: Economic valuation), and by demonstrating the contributions that different disciplines can make through the expansion and publication of case study research.

As infrastructure is created to embed ES assessments in specific governance institutions, it will be impossible and potentially unnecessary to maintain the disciplinary heterogeneity that exists within the wider community. However, ES assessments still require skilled interdisciplinary teams, particularly if they are to capture social and cultural values as well as the biophysical elements of ES. Assessment approaches also legitimise some knowledge claims at the expense of others. In the context of transdisciplinary assessments, it is therefore important to co-develop the design of the research between knowledge holders and to be open about methodological and data-related choices. This consideration requires the deployment of trained social scientists to develop suitable processes for knowledge co-production (see, e.g. (Hauck et al., 2015). Equipping public bodies with the necessary skills requires significant investment as Environmental Impact Assessments (EIAs) and policy appraisals are currently not necessarily conducted by teams of researchers with interdisciplinary skills (Rozas-Vásquez et al., 2018; Turnpenny et al., 2014; Wawrzyczek et al., 2018). It is in this context that it becomes crucial to retain a diverse, reflexive community of practice outside of any specific attempt to institutionalise the concept; as discussed above.

The importance of inter- and transdisciplinary research and assessment approaches identified in our survey also gains strong support within the ES literature (Ainscough et al., 2018; Albert et al., 2017; Carmen et al., 2018; Costanza et al., 2017; Steger et al., 2018). This acts as a guiding principle in the broad sense that it rejects narrow disciplinary approaches to ES assessment and valuation, supporting the norm of collaborative working and respect for different knowledge types.

3.4.4 Integrating sustainability and ecosystem services

A need to focus on the principles of sustainability was emphasised during events at the conference and became a core element of the Antwerp Declaration. Sustainability is usually understood as equitably meeting the needs of current generations without reducing the capacity of future generations to meet their needs

(WCED, 1987). As sustainability is not necessarily implied by the ES concept, many authors have sought to synthesize the two concepts to ensure that the ES concept is applied in a manner consistent with the principles of sustainability (e.g. Bennett et al., 2015; Ekins et al., 2003; Jacobs et al., 2013; Schröter et al., 2017). Key points made in this literature are, first, that the biophysical processes underpinning ES (and inherent limits in their ability to survive under different levels of stressors) should not be lost behind the 'stock' metaphor of ES. Second, stakeholder preferences and values should form part of ES assessments, to ensure people's needs are equitably accounted for.

Jacobs et al. (2013) stress the need to refocus ES research around a 'strong' notion of sustainability. These authors suggest the majority of ES research focuses on the efficient use of ES, but not the inherent limits and boundaries of the reproductive capacities of underlying natural capital. Jacobs et al. (2013) also emphasise the centrality of fairness and equity to the sustainability concept and suggest that distributional effects should be central to any ES analysis.

Schröter et al. (2017) discuss ES as a descriptive and normative scientific concept, whose application may conflict with the principles of sustainability. They claim that "if the ecosystem service concept is understood as contributing to sustainability, ecosystem services need to be conceptualised through sustainability strategies rather than assessing all forms of natural resource use in aggregated, snap-shot assessments" (Schröter et al., 2017, p. 41). Cavender-Bares et al. (2015) seek to synthesise economic, ecological and systems theory to integrate the ES concept and sustainability. Principally, they suggest accounting for the ecological mechanisms underpinning services in the way assessments are carried out, particularly the inherent biophysical limits of these processes. By integrating preferences and values of different stakeholders, coupled with a systems dynamics approach, ES assessments could consider how the whole system might develop over time (Cavender-Bares et al., 2015). Similarly, Bennett and Chaplin-Kramer (2016) point to the development of a socio-ecological systems perspective as a step forward in integrating sustainable use to the ES research agenda (although it is not clear that this is an 'advancement' as much as a return to the roots of ES science, given its origins in systems ecology (Costanza et al., 2017; Odum, 1971)). Despite all these calls, sustainability issues of ecological thresholds and fairness are still often ignored in ES research and practice (Dendoncker et al., 2018).

Focusing on principles of sustainability, coupled with consideration of social and cultural values of ES, was seen as key to ensuring the concept was not misused or used to justify environmentally degrading activities (Cross-cutting theme 2). Here we reiterate, with the support of respondents who contributed to the development of the Antwerp Declaration, the call to adopt the normative and analytic content of the concept of sustainability in discussion and application of the ES concept. We add that as the ES concept is embedded as infrastructure in planning and decision making in different contexts, the need for this to be coupled with the principles of sustainability becomes greater.

In terms of the main types of pluralism we have discussed, the notion of sustainability provides limits to the epistemological and methodological approaches within ES research, whilst also placing it within a broader normative framing. It is therefore a useful concept to guide the discussion and practice around the ES concept. This has ramifications for the types of epistemological, theoretical, and methodological approaches to ES research and practice compatible with sustainability.

A heavy focus on human values, or biophysical processes, whilst not precluded by a commitment to sustainability, should also be treated with caution. Methodologies that seek purely to understand how humans value their environment will not capture ecological dynamics and limits. Similarly, approaches focused purely on the biophysical underpinning of ES may miss the important distributional impacts of changes between different user groups. At the broad level of research and policy-science innovations, this is not problematic as studies may seek to answer certain questions or develop new methods. However, as infrastructure is created, it is important that neither values, nor biophysical dynamics are neglected. This reinforces the need to ensure that inter- and transdisciplinary practices are carried forward as the concept is institutionalised.

The three guiding principles that emerged from this survey are mutually reinforcing: a consideration of social and cultural values, inter- and transdisciplinary approaches and a commitment to the principles of sustainability. Such principles can accommodate a broad range of theoretical, epistemological and methodological approaches, whilst guarding against an ‘anything goes’ approach to the application of the ES framework.

3.4.5 Limitations and future research

User group identifications in our survey broad and not defined during the data collection, leading to potentially different interpretations between participants. Participants were also not able to identify as multiple user groups, which may not reflect the way that these roles can overlap. We also received fewer responses from those identifying as policy makers or practitioners than those identifying as academics. We were therefore not able to explore in detail the variety of different roles connected to varying uses of the ES concept outlined above. To gain a more nuanced understanding of how the ES concept is perceived by different user groups, further research will be needed with a more targeted sampling approach.

Future work may also build upon the distinction between set infrastructure and a broad, pluralistic ES community. These two strands are undoubtedly already in existence and we do not suggest that critical debate is waning within the ES community. Yet the ES concept is likely to become increasingly embedded in policy and decision-making institutions moving forward. As this happens, there may be a need for a more substantive elaboration of the necessary structures to ensure that the critical, pluralistic perspective on the ES concept is maintained and crucially kept in dialogue with the construction of contextually specific infrastructure.

Part of this process may be cross jurisdictions reviews of the way that the ES concept is being embedded at sub-national, national, and international level. Studies of individual jurisdictions and some comparisons are beginning to emerge, but not yet in a systematised way (Bezák et al., 2017; Leone et al., 2016; Mauerhofer and Laza, 2018a; McKinley et al., 2018). We suggest that such studies would benefit from considering the guiding principles laid out in this paper. These principles formed the basis of the collaboratively developed Antwerp Declaration and are supported by other literature as outlined above. We suggest that these may constitute potentially useful frames to reflexively assess the institutionalisation of the ES concept.

3.5 CONCLUDING REMARKS

There are advantages and disadvantages to the ES concept being a boundary objects or set infrastructure, and likely these roles represent poles on a spectrum rather than a binary split. We find these two notions useful lenses for understanding the role of the ES concept at the science-policy interface, and for framing the views

of different user groups. As the concept is further institutionalised in governance institutions, it is important to remain cognizant of the trade-off that exists between these two roles and to not lose sight of the political choices necessary for the creation of set infrastructure.

The structured pre-conference survey and the participatory process of developing the Antwerp declaration have helped to identify different major purposes of the ES concept, including its function as awareness raising tool, scientific approach, and decision-making aid. The integration of the principles of sustainability and the inclusion of social and cultural values were seen as major research frontiers.

Although our findings are based on large number of responses of relevant stakeholders (n= 121), they are biased towards the European research community, and the segmentation of policy and practitioner stakeholders could not be clearly defined. Nevertheless, they emphasised research needs that have been identified and discussed in the literature for some time thus affirming and supporting existing arguments, whilst providing and guidance to support application of the ES concept. We suggest that surveys of the wider community to understand the ES concept provide a valuable approach to encourage nuanced discussion and reflexivity and prevent polarisation of the debate.

AFTERWORD

Thesis questions

Q1. What principles should guide the operationalisation of the ES concept?

Three factors were identified as guiding principles for the application of the ES concept. First, the foregrounding of plural value types, with a focus on social and cultural values, and the development and deployment of valuation approaches suited to capturing these value types. Second, inter-disciplinary engagement, as well as trans-disciplinary engagement with non-academic knowledge holders, recognising the diffuse nature of much knowledge regarding ES. Finally, the need to explicitly couple the ES concept with sustainability principles, defined as equitably meeting the needs of the current generation without impacting the ability to meet the needs of future generations.

The principles are mutually reinforcing. The principles of sustainability include both the sustainable and equitable use of resources. Assessing equitable use requires an understanding of the range of ways ecosystems are valued, and by whom. Ensuring both long term sustainability and equitable use inevitably calls for the engagement of a range of academic disciplines and wider stakeholder knowledge.

Of these three principles, sustainability can be there be seen as the most central. This is because it effectively implies the other two, whereas the other two do not imply the integration of the principles of sustainability. Put another way, it is almost impossible to integrate the principles of sustainability into ES work without considering a range of values and engaging with multiple disciplines. Conversely it is possible to adhere to the second two guiding principles without necessary accounting for sustainability.

As discussed in section 3.4.4, there are number of attempts in the literature to conceptually integrate the ES concept with principles of sustainability. These include focusing on the biophysical processes underpinning ES, and considering stakeholder preference and values (e.g. Bennett et al., 2015; Ekins et al., 2003; Jacobs et al., 2013; Schröter et al., 2017). Jacobs et al. (2013) suggest that more attention must be paid to the boundaries of biophysical systems that if transgressed will undermine the system. This is in contrast to much ES research and practice that instead focuses on efficient use as to maximise extraction of value.

The implication of integrating the principles of sustainability into uses of the ES concept is that we must be explicit about the need to place limits on the usage of natural system. Furthermore, if we are to avoid the ‘complexity blinder’ issue discussed in Section 1.4.3, we must take a precautionary approach to the level of extraction that a system is capable of sustainably managing. This has substantial implications for efforts to integrate ES into practice. I discuss these implications and make further suggestions for how to integrate the ES concept and principles of sustainability in Section 7.2 in the conclusion.

Impact on understanding of the ES concept

This paper assisted in my understanding of the concept in two distinct ways. First, it was clear from the survey that the ES community represented by participants had a view of the normative principles that the ES concept should represent. These align most with what I have been describing as the pluralistic understanding of the ES

concept. Participants were sceptical of the notion that market prices are a useful metric for ES assessment. They are epistemological pluralism and integration of different knowledge types is central to the inter- and transdisciplinary approaches supported by participants. They also believe that sustainability principles, including a concern for equity, should be used to frame applications of the ES concept. In this paper I offer the critical and reflective wider community of ES researchers as a bulwark against potential 'misuses' of the concept in specific policy settings.

Second, the importance of the process of institutionalisation became apparent through writing this paper. Policy makers require more specificity, they require precise tools and methods that can be used to implement the ES concept in practice. What I refer to as infrastructure, borrowing from Steger et al. (2018). This infrastructure has both an instrumental and a normative element. It is instrumental, in that it is a necessary step to allow policy makers to translate the ES concept into practical policy and decision-making tools. However, it is also normative, in that the ambiguity within the concept cannot survive the process of infrastructure creation. The form that actually existing infrastructure takes will therefor institutionalise certain features of ES concept at the expensive of others.

To demonstrate the transformation of ES as a boundary object into set infrastructure, I present a short case study in Box 1.

Relevance to reductionist vs pluralist potentialities

The reductionist tendency, market prices and a neoliberal approach to environmental governance found little support amongst our survey respondents in this chapter. The majority of those surveyed supported an interpretation and application of the ES concept that align with the more pluralist perspective. Whilst this is encouraging, the respondents were all researchers, practitioners, or policy makers familiar with and actively engaged in debates and conversations around the ES concept. Their views are not necessarily representative of policy makers more broadly. There is no guarantee that their vision for the concept will be reflected in how it is applied in practice as it becomes more established and widespread within environmental governance. This process of institutionalisation is beyond the control of those within the ES community, it is a process driven by a range of contextual factors such as existing institutional forms, norms and traditions and existing policy priorities.

This chapter emphasised the need to focus on the process of institutionalisation. Ultimately the multiple contradictory trends within ES thought will be resolved in a specific form as the concept is institutionalised. This therefore poses the question of how this process of institution takes place, and the factors determining how the contradictions resolve themselves. These are themes that I seek to explore through an empirical case study in the next chapter.

Box 1. Case study: Nature's Contributions to People in the IPBES process

This box presents a case study of the process of infrastructure creation, where the ES concept has been codified to fit a particular institutional context. This case study is based on research I undertook as part of the Young Ecosystem Services Specialists group following the 2018 IPBES conference in Medellin, Colombia (Kadykalo et al., 2019).[9] The original research was intended to provide clarity to debates regarding the novelty of the Nature's Contributions to People (NCP) concept vis-à-vis the ES concept. Here I draw upon the results of this research to discuss how the NCP concept fits into the understanding of the ES concept I have been developing in this thesis. I make the argument that the NCP should not be seen as an entirely novel concept, but as the result of a political process to define the ES concept in the context of IPBES.

Background of the debate

In 2017, IPBES shifted away from using the ES concept and instead adopted the NCP framework. An overview of the concept was published in *Science* (Díaz et al., 2018). The authors of this article identify a number of reasons for seeing the NCP concept as being an improvement on the ES concept. The article triggered a substantial number of responses from the ES community. Many were refutations of the claims of novelty being made by authors of the *Science* paper (Braat, 2018; de Groot et al., 2018; Maes et al., 2018). A number made the case for pluralism of framings, attempting to quell arguments over the superiority of either concept (Faith, 2018; Peterson et al., 2018).

[9] See 'Declaration of own work' section for overview of my contribution to this article. The methods presented here are adapted from the published article, with the exception of Figure 17, the remaining text is entirely my own work and does not appear in the published article.

Systematic comparison

To add clarity to the debate regarding the novelty of the NCP concept, we developed a methodology to identify similarities and differences between NCP and ES. There was very little existing literature using the NCP concept available at the time. The 2018 IPBES assessments adopted the term, yet much of the research had been completed before the terminology was changed (Faith, 2018). We therefore compared the claims of novelty made by NCP proponents, and compared these to existing ES literature.

We first identified 11 claims of novelty made in the existing literature on NCP. For nine of these, we developed a string of related key words to search the ES literature (see Kadykalo et al. (2019) for full details). For each claim we quantified the extent to which existing ES literature addressed the claim based on the literature searches. We then undertook a qualitative analysis by reading through titles and abstracts of each of these papers. The further two claims, 'generalising perspective' and 'fuzzy and fluid reporting groups and categories' were not deemed appropriate for generating key words and a purely qualitative assessment was conducted.

Each claim was assessed against a three-part framework of novelty, status, and trend. A claim was considered novel if addressed by less than 50% of the ES literature, based on keyword searches. Status was defined as one of: 'not addressed' (whereby no keywords returned ES literature that addressed the NCP conceptual claim), 'emerging' (based on evidentiary support of relevant ES literature), or 'well-embedded' (based on established ES conceptual frameworks and classification schemes). Third, NCP conceptual claims were classified into one of the three ordinal classes of trend: 'unknown', 'maintained' (whereby the amount of relevant ES literature on the NCP conceptual claim is approximately steady from year to year), or 'increasing' (whereby the amount of ES literature on the NCP conceptual claim shows an exponentially increasing trend in recent years). None of the literature searches indicated decreasing trends. Our results are summarised in Figure 17.

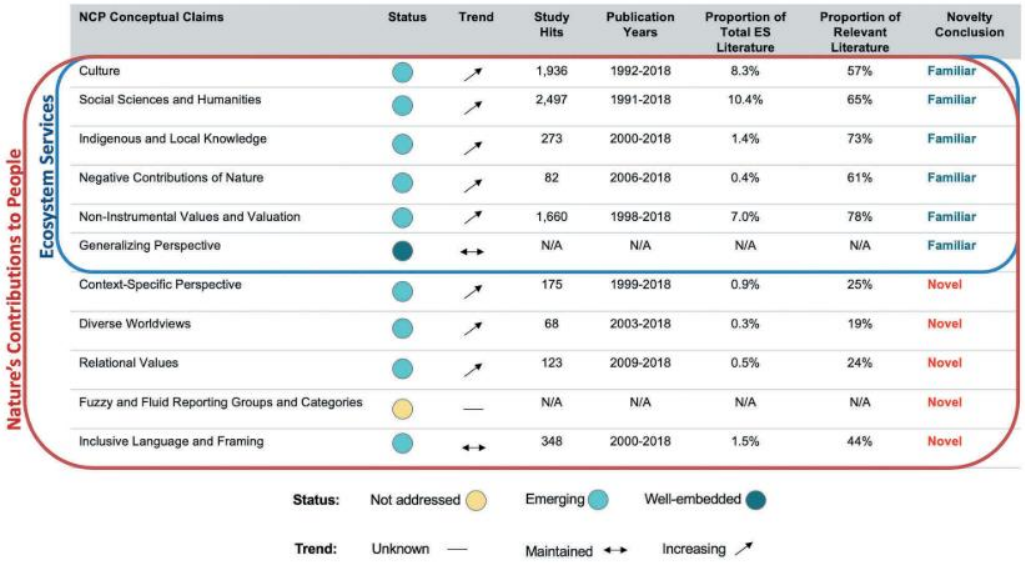

Figure 17. Results of review comparing 'ecosystem services' and 'natures contribution to people'. Reproduced from Kadykalo et al. 2019

Discussion

Our review demonstrated that the NCP concept does not represent a paradigm shift from the ES concept as claimed by its originators (Díaz et al., 2018). Many of the claimed conceptual advances can be found in existing ES literature. The NCP concept instead does two things. It explicitly integrates existing trends within ES, and it attempts to formalise ambiguity and flexibility through the introduction of the localising and generalising perspectives and the fuzzy and fluid reporting criteria.

The generalising perspective includes 18 broad categories of service, divided into regulating, material, and non-material. The localising, or context-specific, perspective is then brought in to acknowledge that these general categories may not be appropriate or applicable to a particular context. This leaves room within the broad concept of NCPs for their redefinition within a specific context, allowing for local knowledge traditions and understandings of the human-nature relationship. Fuzzy and fluid reporting categories refers to the fact that some NCPs can fall within multiple types. For example, food can be a material contribution, but also hold cultural significance and be seen to provide a non-material contribution.

This attempt to formalise flexibility may be interpreted as a response to the same issue identified in Chapter 1 of this thesis – that it is not possible to converge viewpoints around the ES. Rather than accepting the ES concept as a boundary object, the NCP concept seeks to formalise this diversity. Yet, in doing so they have caused kick back from the ES community – many researchers have not accepted the invitation to work with the NCP framing, expansive and accommodating though it is. The debate that ensued from the introduction of the NCP concept is symptomatic of the level of disagreement over what the ES concept entails, even within the community.

'Nature's Contributions to People' is the ecosystem services concept

IPBES are faced with a unique challenge. As an organisation attempted to coherently synthesise research findings from across the globe, it is not possible to retain the level of ambiguity that allows the ES concept to operate as a boundary object. They needed to formalise a conceptual model and categorisation system. At the same time, IPBES covers a wide range of different contexts and seeks to engage with a range of worldviews. It is therefore problematic to narrowly define the concept.

From the perspective I am developing in this thesis, NCP can be understood as an attempt to build infrastructure for the ES concept within the institutional context of IPBES. Specific pressures, debates, and normative considerations within IPBES produced the NCP concept. The change of terminology was a response to concerns of certain parties engaged in the IPBES process regarding the implied utilitarianism of the ES concept. Yet as identified in our paper, NCP does not reflect a substantive conceptual change from the ES concept. And as such many academics outside of the IPBES process have rejected the concept, or at least questioned its usefulness over and above the ES concept. It does not, therefore, seem likely that the NCP concept will replace ES outside of IPBES.

It may use different language, but the NCP concept still adheres to the definition of ES I present in Section 1.5. I therefore understand it to be a specific institutionalised form of the ES concept, rather than a replacement.

4 PATTERNS OF ADOPTION OF THE ECOSYSTEM SERVICES CONCEPT IN SCOTTISH INSHORE MARINE GOVERNANCE

FOREWORD

Origin of chapter

This chapter had two origins. First, the work undertaken in the Clyde alerted me to attempts to adopt the ES concept in Scotland. There was clear desire to experiment with it and use it to guide the planning process in the Clyde. This raised the question of where this desire had come from, how widespread it was and what was driving it. The second origin was the findings of Chapter 3, that demonstrated the importance of the process of institutionalisation for understanding how the ES concept becomes defined in practice.

Thesis questions this chapter addresses

Q2. How does the ES concept interact with existing institutions when put into practice, and what are the implications competing tendencies inherent in the concept?

4.1 INTRODUCTION

Conceptual discussions around ES are slowly giving way in the literature to debates about the implementation of the concept in policy and decision-making contexts. Calls for 'impact' have existed for some time (Daily et al., 2009) and more recently a body of literature has developed that seeks to identify whether, and if so how, the ES concept is used in practice. This literature ranges from studies that take institutions to be relatively stable and seek to understand how ES assessments can best inform policy makers in a particular context (Carmen et al., 2018; Jax et al., 2018; Mckenzie et al., 2014; Posner et al., 2016; Ruckelshaus et al., 2013) to work analysing the institutionalisation of the concept in policy and governance arrangements (Bezák et al., 2017; Bouwma et al., 2018; Goméz-Baggethun and Perez, 2011; Matzdorf and Meyer, 2014; Mauerhofer and Laza, 2018b; McKinley et al., 2018; Rozas-Vásquez et al., 2018; Saarikoski et al., 2018).

Thus far, studies on the institutionalisation of the ES concept suggest only modest advances. For example, at a European Union (EU) level, it has been declared that no new, all-encompassing ES regulations will appear, as this would impact too many existing policy areas (Matzdorf and Meyer, 2014). Indeed Bouwma et al. (2018) suggest that although the ES concept is present in, or at least coherent with, much core EU environmental policy, further integration of the concept is most likely to appear at national and regional scales. Mauerhofer and Laza (2018) also conclude that the ES concept appears largely in soft law and preparatory norms within EU legislation and is effectively absent from enforceable law (with the exception of the recent Invasive Alien Species (IAS) regulations). At the national level, Bezák et al. (2017) report limited uptake of the ES concept in landscape planning in Slovakia, citing complex land ownership structures and the sectoral nature of Slovak land planning as possible reasons. Similarly McKinley et al. (2018) found limited use of the ES concept in coastal governance policy and legislation in Wales, UK.

The institutionalisation of the ES concept is important if it is to alter the behaviour of governments and other decision makers in the longer term. Moving from niche experimentation to part of everyday practice in environmental governance will be essential if the concept is to make good on its potential to rebalance decision making away from narrow economic objectives. At the same time, concerns persist about the possibility of the ES concept backfiring to produce counter-productive and exploitative approaches to environmental governance (McCauley, 2006; Silvertown, 2015). Clearly use of the ES concept in practice is not de facto a positive thing. Studying the process of institutionalisation therefore requires more attention to how the ES concept is defined and shaped as it is embedded in policy and decision-making practices.

Through a case study on inshore marine governance in Scotland, this paper examines the process by which the ES concept becomes embedded in governance institutions. The following research questions are addressed: (1) What factors are driving the evolution of marine governance institutions in the inshore environment in Scotland. (2) To what extent is the ES concept institutionalised in inshore governance in Scotland and what are the drivers and barriers to this process in different governance settings? (3) To what extent do features of the ES concept influence if and how it is adopted in different institutional settings?

The rest of the paper is divided into four parts. In Section 4.2 I set out how I understand institutions and the process of institutionalisation. Section 4.3 then introduces a case study of the use of the ES concept in inshore marine governance in Scotland, with the results presented in Section 4.4. Finally, in Section 4.5 I draw on the results of the case study to reflect on the prospects for the increased uptake of the ES concept in environmental governance.

4.2 UNDERSTANDING INSTITUTIONALISATION

4.2.1 Boundary object to set infrastructure

The ES concept has been understood elsewhere as a boundary object (Abson et al., 2014; Ainscough et al., 2019; Schröter et al., 2014; Schröter and Van Oudenhoven, 2016). A boundary object is a concept that is amorphous enough to be adapted to different contexts and worldviews, but robust enough to act as a channel of communication between these different positions (Star and Griesemer, 1989). This conceptualisation helps to avoid the mistake of overlooking the multiple different understandings of the ES concept that exist, whilst drawing attention to its capacity to bring together diverse user groups.

Understanding ES as a boundary object helps to draw attention to the way the concept changes as it becomes embedded in particular governance arrangements. As identified by Ainscough et al. (2019), as the ES concept is institutionalised it is not necessarily able to sustain the differing interpretations that allow it to act as a boundary object. It must become set 'infrastructure', i.e. "the tools, work practices, terms, and technologies that become embedded and support a community of practice" (Steger et al., 2018, p. 144). This process is likely shaped by pre-existing governance institutions, practices, and norms. I therefore treat process of institutionalisation as bidirectional; that is, I am interested both in how the ES concept shapes institutions, and also how the context shapes the concept itself.

4.2.2 Policy mixes as institutions

Institutions are understood in numerous ways within different theoretical traditions, however I adopt the description given by Vatn (2006, p60) of: "conventions, norms and formally sanctioned rules of a society. They provide expectations, stability and meaning essential to human existence and coordination. Institutions regularize life, support values and produce and protect interests". While many ES might historically have been assessed or valued as part of the policy process, the purported purpose

of the ES concept is to ensure that the full range of relevant benefits and services delivered by particular ecosystems are considered in decision making. The ES concept is intended to move away from decisions based on narrow economic considerations to assist in the transition toward a more sustainable economy (Daily et al., 2009). Integrating the ES concept into policy and decision making will therefore likely require changes to the formal rules governing how the environment and its associated benefits are assessed and valued. This can be understood as a process of institutional change.

ES span socio-ecological systems and do not fit traditional public policy divisions. Instead, a suite of policy tools interacts to influence the delivery of ES (Barton et al., 2017; Ring and Schröter-Schlaack, 2011). Each of these tools is a potential 'venue' for embedding of the concept. Due to the overlapping impact of different policy tools, coordination across them may also impact on ES delivery (Howlett et al., 2015). In order to capture within my analysis, the range of relevant institutional rules, I adopt the concept of a 'policy mix', defined by Ring and Schröter-Schlaack (2011, p. 15) as, "a combination of policy instruments which has evolved to influence the quantity and quality of biodiversity conservation and ecosystem service provision in public and private sectors". These can include a wide range of instruments including regulatory (permits, standards, zoning, planning), economic (taxes, charges, fees), and informational/ motivational (i.e. approaches that pursue behavioural change through education and information). The term policy mix should therefore be understood broadly, to include both actual policy and the various tools and instruments through which it is implemented.

4.2.3 Institutionalisation as institutional change- drivers, barriers, mechanisms

The process of institutionalisation of the ES concept is effectively a process of institutional change, it requires modifying, replacing or creating new institutional arrangements (Meyer et al., 2018). The relative stability or fluidity of institutions, and the specific mechanisms influencing these dynamics, has been the source of much debate (Beunen and Patterson, 2016; Mahoney and Thelen, 2010; Roland, 2004; Sheingate, 2003; Tang, 2011; Thelen, 2000; Thiel et al., 2015; Vatn, 2006; Wegerich, 2001). Earlier theories of institutional structure placed great emphasis on positive feedback loops and lock-ins; systemic attributes of institutions that make radical departure from the status quo increasingly difficult or costly over time

(Pierson, 2000; Thelen, 2000). In general, institutional lock-ins appear because “as social actors make commitments based on existing institutions and policies, their cost of exit from established arrangements generally rises dramatically” (Pierson, 2000. p. 259).

As Uyarra (2009. p. 132) observes: “policies are adopted not on a tabula rasa, but in a context of pre-existing policy mixes and institutional frameworks which have been shaped through successive policy changes.” This institutional landscape engenders certain practices and behaviours, which act to lock-in the status quo and limit the scope for, or increase the cost of, novel policy innovations. For example, Mahzouni (2015) describes how pre-existing housing policy, the technologies and practices of the construction industry, and embedded patterns of energy use by home owners all acted to stymy the objectives of an initiative to increase home energy efficiency in a district of Stockholm. In the context of water markets and allocation policies, Garrick et al. (2013) show how institutional design can influence infrastructure investment and water use behaviour, making transition even to more efficient regimes increasingly difficult over time.

Specifically in relation to ES, Saarikoski et al. (2017) identify several institutional ‘challenges’ to adopting the ES concept, including competing interests, political agendas, scientific disputes, professional norms, and lack of vertical and horizontal integration of policy. Several of these can be understood as institutional lock-ins. For example, if certain interests benefit from the status quo, they are less likely to support changes towards an ES-based approach. Similarly, existing institutional arrangements can create and enforce certain professional norms, which may not be compatible with an ES-based approach. Mauerhofer and Laza (2018) note that in relation to the EU IAS regulations, although the protection of biodiversity *and* ES is mandated in the two EU countries studied, relevant competent authorities continued to see their primary role as protecting biodiversity.

While accepting them as important dynamics, an over emphasis on lock-ins and path dependence should be avoided (Mahoney and Thelen, 2010; Sheingate, 2003). Taking lock-ins as immutable forced early theorists of institutional change to look to exogenous forces to explain change; that is, large perturbations that destabilised self-reinforcing mechanisms (Mahoney and Thelen, 2010; Sheingate, 2003; Tang, 2011). The implied ‘punctuated equilibrium’ model is unfulfilling given the fact that institutions can be seen to change slowly over time (Beunen and Patterson, 2016;

Everard et al., 2016; Thelen, 2000). More recent work sheds light on how the internal dynamics of institutions allow for gradual change (Beunen and Patterson, 2016; Mahoney and Thelen, 2010; Tang, 2011). These theories place greater emphasis on the role of ideas, and the agency of individuals or groups to utilise ambiguity and tensions within institutions to bring about change (Howlett et al., 2017; Mahoney and Thelen, 2010; Schmidt, 2008; Sheingate, 2003).

By elucidating internal mechanisms of change, gradualist theories reduce the need to appeal to exogenous forces to overcome institutional lock-ins. Yet lock-in type mechanisms that act to maintain the status quo are clearly still relevant to an understanding of institutional dynamics. The process of institutional change can therefore be understood as the interplay of forces seeking to maintain the current system, and forces acting to change it (Thelen, 2000). This dynamic understanding appears better able to account for observed patterns of institutional change than can older, equilibrium-based approaches. I will use this understanding of change to explore the institutionalisation of the ES concept in the context of inshore governance in Scotland. I seek to identify the trajectories and drivers of change within different institutional settings, and to use these to understand patterns of uptake of the ES concept.

4.3 CASE STUDY

4.3.1 Overview

My case study focuses on the marine inshore (within 12nm) area in Scotland, UK. Scotland has a long (Approx. 18,000 km) and varied coastline, characterised by islands and fjordic sea lochs on the north and west coast, and sea cliffs and rocky coastlines on the east. Fishing has always played a major role in Scottish economic and cultural life, growing to an industrial scale during the herring boom of the late 1800s and early 1900s. Today, inshore fisheries primarily target shellfish such as nephrops and scallops but are still a vital industry for many rural areas. These fisheries now compete for space with a range of other industries such as aquaculture and renewable energy generation. Aquaculture, in particular, is seen as a key growth area by the Scottish Government, with a target to double the size of the sector by 2030 (Scottish Government, 2015). Similarly, the Scottish Government is committed to meeting 100% of its energy demand through renewable sources by 2020, with most growth potential in this sector being marine based.

The devolved Scottish Government has full legislative control over the majority of inshore policy areas, with the UK Government retaining competency only over telecommunications, shipping, and oil and gas. A need to balance the growing 'blue economy' with conservation objectives was recognised early in Scotland and efforts in marine planning are relatively advanced compared to many European countries. Scotland began marine planning prior to the introduction of the EU Marine Spatial Planning Directive, and work on the first Scottish National Marine Plan (NMP) helped to inform the Directive. Scotland has adopted a two-tiered approach to marine planning, with a national plan setting high level policies and objectives and regional plans being developed through stakeholder partnerships. Eleven marine regions were designated, with two regions acting as pilots for regional marine plan development. The first national plan was published in 2015 and one regional plan is currently operational, with another in development. The Marine (Scotland) Act 2010, under which marine planning is carried out also contains a renewed approach to marine licensing, and provisions for the designation of Nature Conservation Marine Protected Areas (MPAs). To date, 17 MPAs have been designated under the Marine (Scotland) Act 2010 within 12 nm of the coast. These Nature Conservation MPAs form part of a network of MPAs that includes Special Areas of Conservation designated under the EU Habitats Directive, and Special Protected Areas designated under the EU Birds Directive.

I seek to identify ways in which the ES concept is being integrated into the policy mix governing inshore Scottish waters. I focus specifically on three areas of policy, conservation, planning and commercial sectoral regulation, with a particular focus on fisheries and aquaculture. This case study has been selected for several reasons. First, inshore governance in Scotland is undergoing significant changes, increasing the opportunity to adopt the ES concept (Bouwma et al., 2018). Second, much current research focuses on the institutionalisation of the ES concept in terrestrial governance, with the marine environment less studied (with some notable exceptions, e.g. Drakou et al., 2017; Veidemane et al., 2017). Finally, I am familiar with the context having been based in Scotland and having undertaken previous work related to inshore governance.

4.3.2 Research approach and data collection

Much existing research on ES use is relatively narrow in scope, "preventing a deeper, contextual analysis of the level of ES integration and influencing factors"

(Rall et al., 2015, p. 231). The research design adopted here aims to build a holistic picture of inshore governance in Scotland to identify the factors driving the evolution of different institutions, and different uses of the ES concept. Developing an in-depth knowledge of factors driving inshore governance changes was necessary to contextualise each instance of ES use. Data were primarily gathered from two sources – policy documentation and semi-structured expert interviews. First, core policy documents relevant to the inshore marine area were identified and analysed these for use of, or coherence with the ES concept. Second, semi-structured interviews were then conducted with 20 informants working in industry, public bodies or the third sector in the marine and coastal governance sector. These interviews included general questions about changes that had happened in the sector, as well as specific questions about the use of the ES concept (see Table 5 for information on interviewees). For each instance of ES use identified, any publicly available supporting documentation was then gathered and read.

Table 5. Table showing the area of work, sector and identification code for each interviewee

Area of work	Sector	Code
Fisheries	Private	FISH01
Conservation	Public	CON02
Science	Public	GOV03
Science	Public	GOV04
Aquaculture	Public	GOV05
Planning	Public	GOV06
Planning	Public	GOV07
Conservation	Third	CON08
Aquaculture	Private	AQ09
Fisheries	Private	FISH10
Aquaculture	Public	GOV11
Planning	Private	PLAN12
Conservation	Third	CON13
Conservation	Third	CON14
Conservation	Public	GOV15
Fisheries	Private	FISH16
Fisheries	Private	FISH17
Fisheries	Private	FISH18
Planning	Public	AC19
Planning	Public	PLAN20

4.3.2.1 Coding framework for policy analysis

To identify the current level of integration of the ES concept, I adopted an approach developed by Bouwma et al. (2018) (building on a framework originally developed by Helming et al. (2013)) in their analysis of EU policy. This framework assesses the level of coherence of a particular policy with the ES concept in three respects:

1- Coherence at level of definitions – does the policy use the language of ES?
2- Coherence at level of aims or objectives – do the aims and objectives of the policy align with the ES concept or are they compatible with the ES concept. Are specific categories of ES or individual services mentioned?
3- Coherence at level of implementation – do the reporting or monitoring requirements integrate ES. Are there financing mechanisms linked to ES?

All policy documents were coded in Nvivo to identify evidence of the ES concept being used in the aims, objectives, and reporting mechanisms of each policy. Results were then used to classify policies using a typology adapted from Bouwma et al. (2018) (Table 6).

Table 6. Definitions for the level of a coherence a policy has with the ES concept. Adapted from Bouwma et al. 2018.

Type	Description	Level of coherence with ES concept
Type 0	No ecological or environmental issues mentioned	None
Type 1	Environment mentioned but neither a prominent objective nor relevant for/mirrored in policy measure design or monitoring	Very low
Type 2	Environment mentioned and/or relevant for/mirrored in policy measure design or evaluation	Low
Type 3	Strong environmental framing and evaluation, but the ecosystem services terminology is not used – some services might be mentioned	Moderate
Type 4	Contains framing around ecosystem services and /or use of terminology but is hardly relevant for/mirrored in policy measure design or evaluation	High
Type 5	Ecosystem services fully embedded throughout the policy, including objectives and policy measure design and monitoring	Very high

4.3.2.2 Analysis of interviews

Interviews were coded for both contextual information and information relevant to specific uses of the ES concept. Analysis took a two-stage process. Initially, interviews were coded using the high-level framework in Table 7. Coding was conducted separately for each sector. All coding was conducted in Nvivo.

Table 7. High level codes used to organise interview data

Code	Subcode	Description
Contextual	Significant events	Changes in organisations, legislation, regulation, or policy
	Drivers of change	Factors influencing changes in the sectors governance
ES Use	Specific uses	Explicit attempts to adopt the ES concept
	Barriers to uptake	Factors limiting the potential for the use of the ES concept

Coded text was then compiled for each subcode in Table 7 on a sectoral basis. Data on 'Significant events' and 'Drivers of change' were used to produce a timeline for each sector and a narrative description of recent changes (Section 4.4.2). Data on ES use was corroborated with additional documentation where possible, and developed into a narrative description for each sector (Section 4.4.3) and a summary table of different uses. Barriers that were identified in every sector are discussed separately in Section 4.4.4.

4.3.2.3 Corroboration through document review

For each use of the ES concept identified through interviews, where possible, corroborating documentation was identified. See Appendix 1 for a full list of documents reviewed.

4.4 RESULTS

4.4.1 Policy analysis

Table 8 details the policies identified and Figure 18 shows the spatial extent covered by each policy document. The policy analysis shows little formal integration of the ES concept into marine policy. The results of the coding of the core policies in the policy mix is summarised in Table 9. The ES concept is explicitly referenced in four of the policies analysed; the latest addition to the biodiversity strategy, the National Planning Framework, the Strategy for Marine Nature Conservation, and the Scottish

NMP. In the latter three of these the concept is mentioned only in passing or in the glossary and is not relevant to the policy design or evaluation. Within the most recent document of Scotland's biodiversity policy (2020 Challenge for Scotland's Biodiversity) there is significant discussion of the ES concept. This is the only place where ES are relevant to the policy's evaluation, although the focus is on measuring the natural capital component of ES generation. Progress towards the goals of the biodiversity strategy is measured in part through a Natural Capital Asset Index (NCAI). Although there are plans to introduce it, the marine environment is not currently captured in the NCAI (SNH, 2019). Therefore, although the 2020 Challenge for Scotland's Biodiversity is most coherent with the ES concept, this is not true in its application to the inshore marine area. ES terminology and framing was entirely absent from all other policies analysed. Notably, the ES concept only appears in policy released since 2013, however it is currently absent from the River Basin Management Plans, despite the latest iteration of these plans being released in 2015.

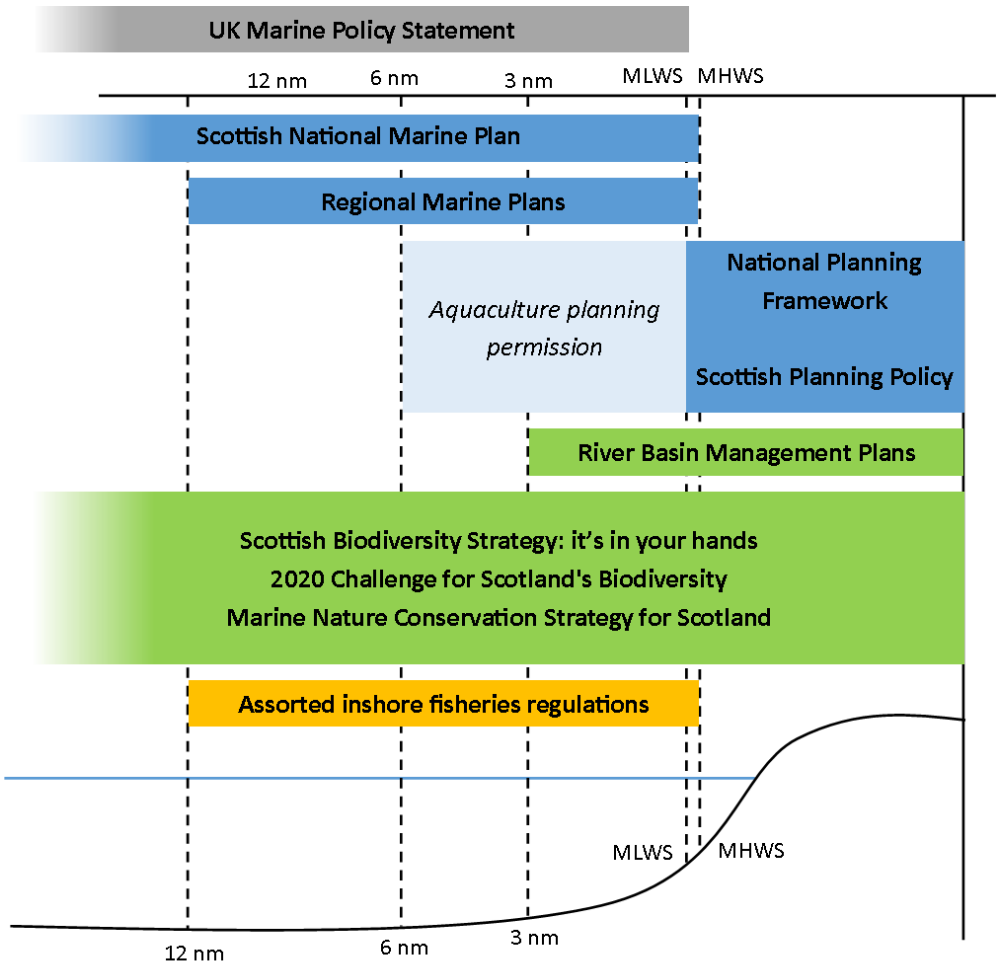

Figure 18. Diagram showing the jurisdiction of the main policy instruments in the policy mix

Table 8. Summary of policy documents reviewed

Name	Purpose	Date	Review period
Scotland's Biodiversity: It's in your hands	A strategy for the conservation and enhancement of biodiversity in Scotland	2004	Will be reviewed where circumstances appear necessary
Marine Policy Statement	The framework for preparing Marine Plans and taking decisions affecting the marine environment.	2011	Will be reviewed where circumstances appear necessary
2020 Challenge for Scotland's Biodiversity	A strategy for the conservation and enhancement of biodiversity in Scotland. An addition to the 2004 Scotland' Biodiversity strategy	2013	Will be reviewed where circumstances appear necessary
Strategy for Marine Nature Conservation in Scotland's Seas	The strategy sets out aims and objectives for protecting and, where appropriate, enhancing valuable marine biodiversity.	2011	Expires in 2020

National Planning Framework 3	Spatial plan that sets out where development and infrastructure is needed to support sustainable and inclusive growth.	2014	Every 10 years
Scottish Planning Policy	Policy statement on how nationally important land use planning matters should be addressed across the country. Including aquaculture development	2014	Every 10 years
Scottish National Marine Plan	Covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles)	2015	Every 3 years
River Basin Management Plans	Protects and improves Scotland's water environment for the benefit of people, wildlife, and the economy	2015	Every 6 years

Table 9. Level of coherence between core policies relevant to Scotland's inshore marine region and the ecosystem services concept

Name	Type	Level of coherence
Scotland's Biodiversity: It's in your hands	3	Moderate
Marine Policy Statement	3	Moderate
2020 Challenge for Scotland's Biodiversity	5	Very high
Marine Nature Conservation Strategy for Scotland	4	High
National Planning Framework 3	4	High
Scottish Planning Policy	3	Moderate
Scottish National Marine Plan	4	High
River Basin Management Plan	3	Moderate

4.4.2 Sector overviews

A timeline of significant events and policy or legislative changes for each sector is presented in Figure 19. A narrative description of recent developments in each sector is provided in the following sections.

4.4.2.1 Inshore Fisheries

Fisheries management in Scotland can be split between the inshore (12nm) region that is the sole responsibility of the Scottish Government, and the offshore (outside of 12nm) that is primarily controlled by, at the time of the study, the EU Common Fisheries Policy (CFP). I include discussion of the CFP here as vessels will regularly fish in both zones and stocks controlled by the EU quota system are fished within

12nm. The core pieces of legislation controlling inshore fisheries (with amendments) are the Sea Fish (Conservation) Act 1967 (size of fish, gear types, species), Sea Fish (Shellfish) Act 1967 (allows local management of fisheries), Inshore Fishing (Scotland) Act 1984 (regulation of species landed, location and methods as well as vehicles used).

Inshore fisheries management in Scotland has recently seen the introduction of Inshore Fisheries Groups (IFGs). After an initial failed pilot project (2009-2013), there are now five Regional Inshore Fisheries Groups (RIFGs) that take different legal form and function around the coast. The process of establishing these groups fed into learning within the Scottish Government regarding the challenges of top-down prescriptive reform. These groups play several related roles but were primarily established to increase the voice of the inshore sector (FISH01) and empower local communities (CON02). These IFGs are also anticipated as a vehicle for the sectors involvement in conservation and planning initiatives (CON02, FISH01, and CON13).

RIFGs groups have brought in various voluntary management agreements and one has brought forward a proposal for a locally managed fishery (FISH01). Although these groups are primarily focused on inshore fisheries, they engage with representatives from offshore fleets as appropriate (FISH10). These groups differ in their status and constitution, and there is a desire for those that are currently volunteer led to be placed on a statutory footing (FISH01).

Two drivers identified in developments around the fishing industry are the need to ensure that rural communities have job opportunities (GOV04) and a desire for further devolution (FISH18 and GOV11). For example, one interviewee said the RIFGs were, “trying to get to a point where there was a more meaningful input at a regional and local level [from a long period of centralised management structures]” (CON02).

Offshore fisheries fall under the Common Fisheries Policy. Here, quota are allocated to member states based on historic catches (prior to the introduction of the system (FISH16)), and total allowable catch (TAC) is set each year following advice from the International Council for the Exploration of the Sea (ICES) based on the principle of Maximum Sustainable Yield – the agreed rate at which a stock can be harvested without decreasing stock biomass over time. Two notable changes have taken place in recent years. The first was the introduction of mixed fisheries advice that factors in species interactions (FISH16). This mixed fisheries advice allows Maximum

Sustainable Yield to be interpreted as a range, rather than as a single point. This range can also be used to integrate social and economic considerations (FISH16). The precise point within this range that is used to set annual quotas can reflect additional sources of information such as fishers' knowledge. One interviewee suggested that policy makers are increasingly willing to step outside ICES advice based on knowledge held by fishers themselves and the known issue of ICES data failing to keep up with annual stock fluctuations (FISH16).

The incentive to become Marine Stewardship Council (MSC) certified was seen as one of the most significant drivers in the industry for adopting an ecosystem approach (FISH18 and FISH17) (FAO, 2003). The ecosystem approach, as defined by the Convention on Biological Diversity, refers to the need to maintain ecosystem services. However, MSC certification does not incorporate this aspect and instead focuses on stock health, management regimes, and the wider environmental footprint of the sector (FISH10).

4.4.2.2 Aquaculture

A large range of specific sectoral regulations are in place governing development in the inshore environment. These include EIAs, Strategic Environmental Assessments (SEAs) and Sustainability Appraisals alongside sector specific regulations.

The aquaculture industry has existed in Scotland since the 1970s and regulation of the sector has evolved significantly. The two most relevant regulatory considerations for aquaculture developments are Controlled Activities Regulations licenses issued by the regulator the Scottish Environmental Protection Agency (SEPA), and planning permission from the competent planning authority, which in the Scottish context falls with local governments. As part of the planning process, developers must submit an EIA that includes a socioeconomic assessment of the benefits of the site to the local economy, a visual impact assessment (AQ09), and an assessment of the impact of any conservation features (GOV06). As part of attempts to streamline the planning process, a pre-prepared template for aquaculture EIAs was released in 2008 (GOV11 and AQ09). Although the EIA process has been streamlined and there have been some changes in emphasis, the scope of the assessments remains unchanged and was largely set by EU legislation (GOV03): as one interviewee commented, "Has the impact assessment changed much?… no, not really, the EU Regulations haven't changed" (AQ09).

First introduced in 2005, Controlled Activities Regulations licenses are now issued under the Water Environment (Controlled Activities) Scotland Regulations 2011, a piece of legislation designed to ensure compliance with the European Water Framework Directive (GOV05). Controlled Activities Regulations licenses dictate the allowable biomass in a site based on the impact on the benthic habitats below and around the site. At the time of this study two significant changes were currently taking place regarding regulation of the environmental impacts of aquaculture. The first was the introduction of a new generation of the model used to assess Controlled Activities Regulations licenses. The development of this model was driven in part by a desire further growth in the sector. The old model did not operate at a biomass above 2500 tonnes, placing an artificial cap on production in some sites (GOV11 and GOV05). At the time of this study, regulators were also consulting on a new approach known as Depositional Zone Regulation (DZR). This approach is designed to increase the ability of regulators to assess cumulative impacts in the same water body, seen as useful for ensuring Water Framework Directive compliance (GOV03).

Aquaculture is a target growth sector by the Scottish government. There is currently a Government mandated presumption in favour of aquaculture developments and one interviewee suggested that there was ministerial pressure resisting further regulation of the sector (CON13). This desire for growth has also been part of a drive to simplify regulation in the sector (GOV11). Although this has led to some changes, there is still the perception in the sector that there is an excess of different processes and regulators (GOV03 and AQ09).

4.4.2.3 Conservation

Environmental protection in Scottish inshore waters is influenced by Scotland's biodiversity strategy (laid out in 'Scotland's Biodiversity: It's in your hands (2004)' and '2020 Challenge for Scotland's Biodiversity (2011)') and takes two key forms, the designation of MPAs and the use of sustainability appraisals in planning applications for marine developments.

Two major types of MPA exist in Scotland inshore waters, those designated under the EU Habitats Directive (Special Areas of Conservation (SACs)) and those designated under the Marine (Scotland) Act 2010 (Nature Conservation MPAs). SACs are designated to protect species and habitats contained on the annex of the Habitats Directive, Nature Conservation MPAs are designated to protect an

identified list of Scottish Priority Marine Features. The identification of Scottish Priority Marine Features was informed by gap checking EU legislation undertaken by the Advisory Group on Marine and Coastal Strategy (AGMACS). AGMACS also began the process of designing an approach to marine planning for Scotland (PLAN12). The first designation of Nature Conservation MPAs took effect in 2014, followed by a round of consultation on management measures. Driven, in part, by the threat of legal action, management measures in existing SACs also recently came under review (CON13).

The main Government agency responsible for nature conservation within 12 nm is Scottish Natural Heritage (SNH). However Marine Scotland, a Government Department, also has responsibility for commercially important species, some of which are included on the Priority Marine Features list (GOV03).

4.4.2.4 Planning

Three main planning regimes are relevant to the inshore waters, working at different spatial scales: local development planning, river basin management planning, and marine planning. The oldest is local terrestrial planning, implemented through 'Local Development Plans' (LDPs) developed under the Scottish National Planning Framework. These LDPs are primarily terrestrial in nature but cover aquaculture development since planning authority for the sector was devolved to local authorities in 2007. Waters inside 3nm are also covered by River Basin Management Plans. Two of these plans exist within Scotland, the Scotland River Basins Management Plan and the Tweed and Solway River Basin Management Plan. These plans seek to ensure Good Ecological Status in inshore ground and surface water, following the EU Water Framework Directive. These plans are mostly focused on rivers, lochs, and ground water, impacting on pollutant levels in coastal waters. They are also of relevance to aquaculture development, much of which sits within 3nm of the coast.

The newest planning framework is Regional and National Marine Planning. The NMP (first published in 2015) is a strategic document prepared in accordance with the 2010 Marine (Scotland) Act and the UK Marine and Coastal Access Act (2009). Regional Plans are currently being developed around the Scottish coast. These must align with the NMP but match the specific activities, pressures, and issues within regional contexts. Two pilot regional marine planning partnerships have been established, one covering the Firth of Clyde marine region and the other the Shetland islands. In the case of the Clyde, the pre-existing coastal partnership

reconstituted as the Regional Marine Planning Partnership (PLAN12) and in the Shetland islands this role fell to the NAFC Marine Centre, a research centre based on the islands. All the above plans are subject to SEAs.

A series of pre-existing coastal partnerships were established in the early 1990s. These bodies are organised under the Scottish Coastal Forum. These partnerships undertook preparatory work for marine planning in 2011/2012, mapping sector-sector interactions (PLAN12). They are seen as likely pre-curser bodies to regional marine planning partnerships (PLAN12). To assist with marine planning, Marine Scotland established and now maintains the National Marine Plan interactive (NMPi), an open access digital GIS tool that compiles data on the Scottish marine area (CON02). The NMP came up for its first review in 2018 and a decision was made not to undertake a renewal of the plan (GOV07). It was considered that the plan had not been in operation long enough to assess its impact (GOV06).

Marine planning is seen as a way to mediate conflict between marine activities in Scotland, including the placement of aquaculture sites and renewable energy (GOV05, GOV04, and GOV03), and of considering cumulative impacts. Climate change was identified as another key driver behind marine planning (GOV04), and the underpinning Marine (Scotland) Act has a strong focus on climate issues (GOV06). The desire for growth in the so-called ‘blue economy’ was also seen as a key driver (AC19, FISH01, and GOV04). Regional marine planning, in particular, have the scope to prioritise and support certain sectors (CON02).

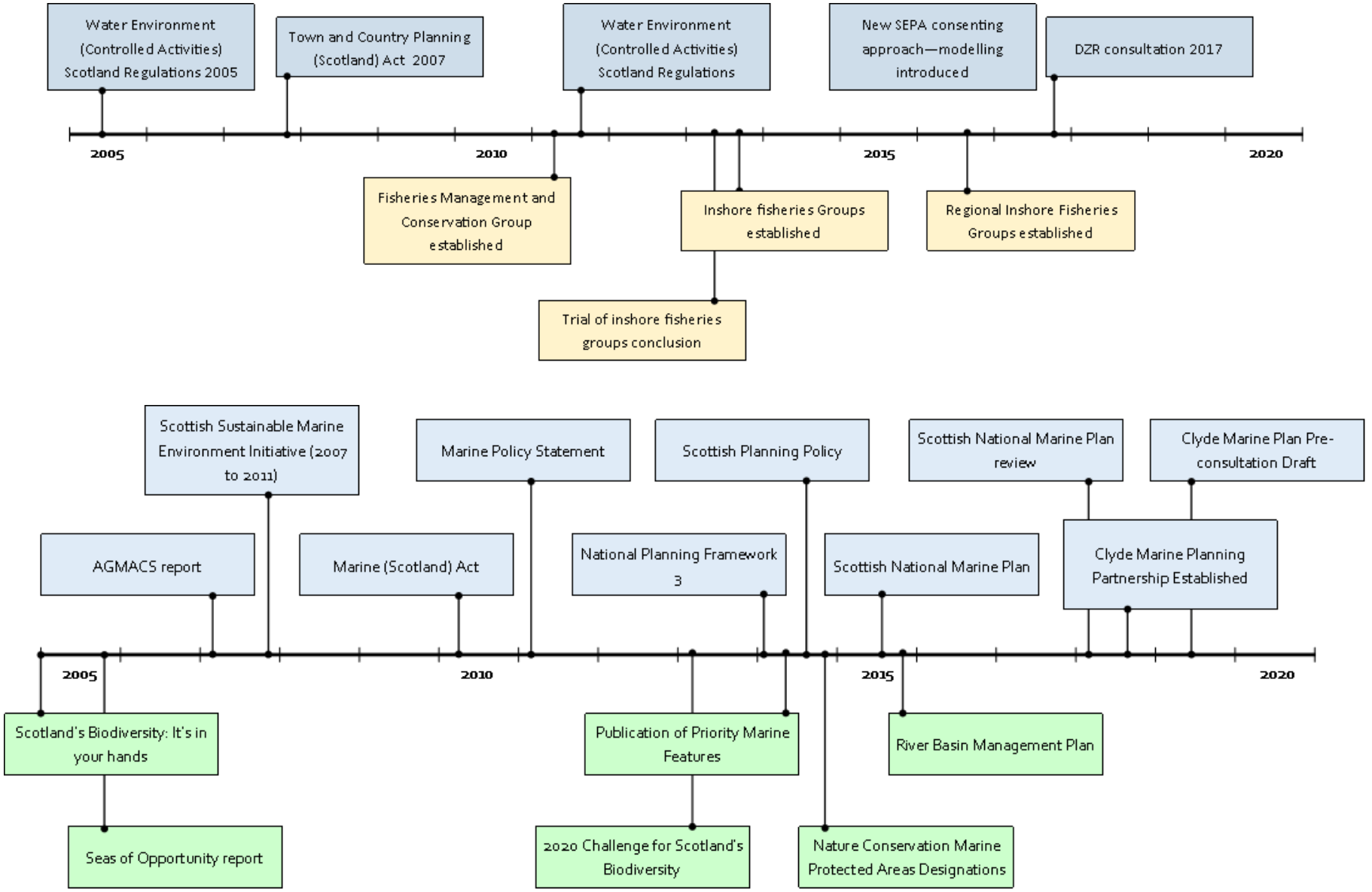

Figure 19. Timeline showing significant legislative or policy changes in policy mix since 2005

4.4.3 Use of the ES concept within each policy area

In the next sections I discuss uses of the ES concept in each sector. A summary of all uses identified is presented in Table 10.

4.4.3.1 Fisheries

Outside of the scientific community, no interviewees in the fishing sector were familiar with the term ES (FISH16). All interviewees were, however, familiar with the ecosystem approach (Pope and Symes, 2000). The Scottish Government had committed to introducing new inshore fisheries legislation before the end of the Parliament in 2021, though this has not occurred (FISH01). One respondent expressed the view that this new legislation represented a chance to embed an ecosystem approach into inshore fisheries management (CON02). Two interviewees discussed the increasing use of ecosystem models in fishing advice, alongside standard single stock assessments (GOV03 and FISH17). Although not currently used in this way, ecosystem modelling provides an opportunity to consider wider ecosystem impacts of fisheries in management decisions. However, the industry's primary interest in such models is in better understanding long term dynamics of fish stock populations and distributions, and the impact of temperature changes (FISH17).

One explicit use of the ES framework in relation to fisheries was a report on the impact of re-implementing a ban on trawling within 3 miles of the Scottish Coast (Marine Scotland, 2014). There is a significant debate on the '3-mile limit', and the report was commissioned by Marine Scotland to assess the issue as part of their preparatory work for a new Fisheries Bill (CON13). This report explicitly adopted an ES framework and reached the conclusion that a 3-mile limit would ultimately be beneficial for Scotland.

4.4.3.2 Aquaculture

An interviewee who worked directly in the aquaculture industry was not familiar with the ES concept (AQ09), however, interviewees working for aquaculture regulators were. One example of an attempt to use the ES framework was identified. An interviewee discussed proposals they had developed to integrate consideration of ES into the regulation of aquaculture by SEPA (GOV11). This attempt was driven in part by Water Framework Directive requirements to assess multiple attributes of a water body: "I was interested to see how we could tie that together in a water body, all the things that SEPA were involved in licensing or controlling" (GOV11). The

intention was then to ascertain the level of ES provision a water body could sustain while maintaining high ecological status (GOV11). Although this proposal was not carried forward by the regulator, it was clear that others at the organisation were keen to pursue this avenue (GOV11).

4.4.3.3 Planning

All interviewees involved in marine planning were familiar with the ES concept. Several interviewees identified national and regional marine planning as the most appropriate institutional context for the adoption of the concept (CON02 and AC19). The concept has high compatibility with the NMP and with the National Planning Framework, potentially opening the way for it to be adopted within Local Development Plans.

Preparatory work for the NMP included consideration of ES (PLAN12) and the option of structuring the plan around ES was discussed but not pursued (GOV07). An interviewee commented that, “we had conversations of tearing the draft up and doing it on ecosystem services, but there wasn’t time… you could do it now. It would be possible to do it now. More people are used to the ideas, there’s more theoretical and analytical work” (GOV06).

Several interviewees referenced an informal meeting group within Marine Scotland that exists to discuss how ES can be considered in their work (AC19, GOV03, and CON02). This has resulted in two initiatives thus far. The first was a project to review the NMP against an ES framework (GOV07). This review assessed existing policies against the UK NEA ES framework to identify which ES they addressed and to look for gaps (GOV07). The results were published in *Marine Science* (Sangiuliano, 2019). It is hoped that the evaluation of the existing marine plan will help to inform later versions of the plan (GOV07). The second initiative of this working group involves adding ES data into the NMPi, though there has currently been limited progress (CON02, GOV07, GOV06, and GOV04).

Several interviewees expressed the view that the next revision of the NMP may be structured around ES (GOV07 and PLAN12). One stated, “we are quite excited to think about, if we completely change the language in the National Marine Plan, which is very sectoral, and base it around ecosystem services, whether it would change some of the decision making” (GOV03). Similarly, another stated, “I think as the understanding of what the ecosystem services approach entails increases, and

because there is a policy context that support a greater level of consideration, I wouldn't be surprised if later versions of the National Marine Plan embraced it a bit more clearly" (PLAN012).

The framework has also been adopted in both regional marine planning pilots. An interviewee stated, "Shetland and Clyde, they've both been going through their first steps. Which is their regional assessment, the state of the sea assessment. And they were both really keen to start to include some content about ecosystem services. Because actually they find it quite a useful way of having a conversation with sectoral interests that disassociates from conflicts" (CON02).

The Shetland Marine Plan was cited by several interviewees as an example where the ES concept was central to early preparatory work and data-gathering (CON14). Much of this work, including the data-gathering methodology, has been published in academic articles (Kelly et al., 2020; Shucksmith et al., 2014; Shucksmith and Kelly, 2014). In the Firth of Clyde, the regional assessment included narrative sections on ES, and the Clyde Marine Planning Partnership (CMPP) included an ES assessment as part of their SEA (CON02). Although one interviewee referred to this primarily as 'window dressing' (AC19), this is likely the first steps to integrate ES. One interviewee commented, "they have put fairly descriptive… where they have an assessment of a certain seabed feature… a fairly descriptive bit of text about what are the ES associated with that. They might be able to go down the line of that becoming a more semi-quantitative, or quantitative assessment for some things that might then have more kind of specific influence in support on policies in the future" (CON02).

One interviewee mentioned a marine spatial planning game that had been developed, with the potential to integrate data on ES, allowing participants to test the impact of different policy options (Steenbeek et al., 2020). A version for the Clyde currently includes 24 different indicators (PLAN12). One interviewee felt that, "when we start rolling out the Clyde version of the Marine Spatial Planning game, the ability to consider.. to click on and click off layers and see over time the knock-on impact of marine planning decisions will be a big eye opener" (PLAN12).

At least one local council has included consideration of ES within their LDP (AC19). This is a potential avenue for integrating ES into how planning decisions are made.

4.4.3.4 Conservation

All interviewees from the conservation sector were familiar with the ES concept. The concept has high compatibility with the most recent policy document (see Table 9). Several interviewees expressed the view that the concept could be used to help communicate the benefits of environmental protection (CON02 and CON08). A number of publications were referred to that attempted to use the ES concept in this way. These included a report into future of inshore fisheries (CON08), a study linking ES and the fisheries sector in Scotland, and work done on the value of recreational diving and angling (CON08) (Brooker et al., 2017; Jobstvogt et al., 2014).

ES provision was also initially included as a selection criterion for potential Nature Conservation MPAs. However, it was decided there were not enough data and the concept was too poorly understood to meaningful inform selection. An interviewee commented that it, "was probably the most leading example in the UK of trying to get ecosystem services language into MPA designation… but it really hasn't been taken up, it has been focused on the protection of rare, threatened or significant species from an EU or Scottish level" (AC19). However, another interviewee commented, "to my mind the MPAs they focus on Priority Marine Features, because that was what was considered to be politically acceptable when they were being designated" (CON13).

One interviewee suggested there was interest in integrating ES provision into the management objectives of MPAs:

> we are starting to think about […] is there a way we can word conservation objectives […] that makes the functionality and relationship to a service or benefit a bit more explicit? Because we would like MPAs to more explicitly be about benefiting fisheries sustainability as well… it makes sense. And we kind of hope they do that anyway, but we want for that to be part of the objectives and the measures just, it can only be a good thing really. So why wouldn't we try and do that? But it is quite difficult, because you have to try and do it in a way that is not just making it unbearably complicated and more wordy that it needs to be. (CON002).

Carbon sequestration was identified as an ES that is currently receiving a significant amount of government research funding (GOV15 and GOV04). This was seen to fit with the wider government focus on decarbonisation and climate change (GOV15 and CON17).

Table 10. Summary of identified uses of the ES concept

Identifier	Description	Sector	Result	Organisation	Categorization	Conceptual model
Use 1	Appraisal of existing national marine plan	Planning	Success – academic publication	Marine Scotland	UK NEA	NA
Use 2	Re-structuring of marine plan	Planning	Not yet implemented by not dismissed	Marine Scotland	NA	NA
Use 3	Adding data layers to NMPi	Planning	Success	Marine Scotland	NA	NA
Use 4	Regional Marine Plan development	Planning	Varies between region	CMPP and NAFC	UK NEA	NA
Use 5	Waterbody level assessment for aquaculture	Sectoral regulation	Failure	SEPA	NA	NA
Use 6	MPA selection criteria	Conservation	Failure	Marine Scotland/ SNH	NA	NA
Use 7	New national performance indicator/ NCAI	Overarching	In progress	Marine Scotland	NA	NA
Use 8	3-mile limit report	Fisheries	No known action	Marine Scotland	Bespoke	Bespoke

4.4.4 Barriers to uptake

Several perceived barriers to the use of the ES concept were identified that applied to all settings.

4.4.4.1 Data reliability

Lack of data was seen as an issue by interviewees (GOV03, GOV07, GOV04, GOV15, and CON02). One commented that, “if you read the National Marine Plan the words ‘ecosystem services’ crop up several times. You could argue we are paying lip service to it, not actually doing it. And that is probably true… why aren’t we doing it? Because we don’t fully understand the potential. And also, we don’t believe that the data are there to enable us to make decisions based on ES assessments at the moment” (GOV03). One interviewee doubted if the necessary data would ever be available, “I simply don’t see how you would get that level of evidence. The carbon sequestration is a perfect example. You are looking at 20 years of data .. and these are methods and techniques that are not that well developed” (GOV04).

4.4.4.2 Valuation problems

Several interviewees explicitly mentioned the immeasurability and intangible nature of many services (FISH17) and the difficulty of valuation (PLAN12, AC19, GOV15, and CON02). Previous studies on the non-use values of MPAs generated excessive figures with high ranges, diminishing support for the valuations (GOV15). One interviewee stated, “I don’t think anyone questions the value of looking into ecosystem services or having a healthy sea. The question is… how much confidence we can have in conclusions… in the 2013 consultation we did on MPAs, the socioeconomic benefits had a massive range. It was millions difference between lower and upper”, adding, “you can’t just bandy about massive numbers if we don’t think they are robust” (GOV15). One interviewee highlighted that alternative options existed to monetary valuation, such as participatory mapping (AC19).

4.4.4.3 Regulatory hooks

Another perceived barrier in many settings was the lack of an explicit regulatory driver requiring the consideration of ES (GOV06). One interviewee observed,

> When you look at the management of an MPA, SNH and JNCC [Joint Nature Conservation Committee] manage on the basis of the condition and conservation objectives of the feature […] But there is no formal consideration of ecosystem

> services, that's where it could be reformed, and I believe JNCC and SNH are thinking… or individuals are thinking about how we could change conservation objectives to include ecosystem services in the management of MPAs. But until there's a regulatory hook… (CON19).

Ultimately much of what happens in sectoral governance is driven by regulation. In particular, EU Directives were frequently identified as a key driver in regulation (GOV04, FISH18, and GOV03). As one interviewee commented

> I don't see [ES] as being a driver.. or not a primary driver for us. There would be people in SEPA who would not agree with that. But the primary driver will be the Water Framework Directive. How we achieve that might be finessed by consideration of broader issues like ecosystem services and so on. But I don't think it will become the primary driver in the short term, or probably even the medium term. (GOV05).

Another commented, citing a review that had been carried out, "No. that was the outcome of the review. There is no place for these considerations (ES) in licensing. Even for a holistic ecosystem approach assessment. Everything is to do with protected areas and protected species. So it doesn't fit" (GOV06). Another interviewee expressed the same view, saying, "that was the problem (lack of regulatory vehicle). There was nothing clearly defined" (GOV11). Whereas conversely, "habitats regs are so engrained in the development process that it is one of the things that you have to consider and crack on with" (PLAN12).

This was also mentioned in SEAs in marine planning, "It comes down to needing regulatory reform of SEA and that is a European directive. So if we are still in the EU then it has to come from that side" (AC19). A similar view was expressed by a government employee, "SEA is based around legal requirements, and the existing legislation does not require these sorts of assessments" (GOV06). Summarising this point, an interviewee commented,

> I have come to the conclusion, though I am not settled on this yet, that policy structures are very prohibitive of including ecosystem services… almost deliberately designed to not incorporate a broader rational communicative, deliberative, pluralistic element. They are designed to shut stakeholders out and focus on simple solutions to these problems. And when they realise these problems aren't simple, they are complex, they have many moving parts, there are different understandings of values and benefits. And they overlap… it's not simple and yet if you look at SEA for example, how do you fit these really complicated and contextual things into

> something like an SEA? Or even and EIA? And people get nervous, because could you stop a development because of 'sense of place' or 'seascape' (AC19).

The Marine Strategy Framework Directive was identified as a potential regulatory hook for ES, with the VECTORS project referred to – "so the Marine Strategy Framework Directive provides an enabling framework to at least put some flesh on the bones of ES if you like" (FISH17). Others highlighted commitments under OSPAR and the Convention on Biological Diversity (CBD) as entailing elements of a duty to consider ES (GOV15).

4.4.4.4 Legal defensibility and need for business clarity

Linked to the above is the need for businesses to have clarity on regulations and for decisions taken to be legally defensible. The need for clarity for fisheries businesses was emphasised by several interviewees, one noting "The industry really wants to know, okay, what does that mean for our business and our community…" (FISH16). This interviewee suggested that the science of ES was a long way away from being reliable enough to be the basis of fisheries management decisions in a way that would be acceptable to industry.

A key focus for regulators and researchers working in the aquaculture sector for government is to ensure their decisions are legally defensible (GOV05). One commented: "In early days they were 4-5 pages and easy to write. Now very substantial documents. Mainly due to desire to minimise opportunity for legal challenge. Drivers are to improve the reliability of the assessments and the confidence of licensing authorities. Mainly to try and avoid legal challenge" (GOV06)

4.4.4.5 Lack of link to national performance indicator

Scotland has a system of national performance indicators, including an indicator to enhance natural capital. These indicators are seen as a key driver of policy formation (AC19), however currently only include one marine indicator focused on fish stocks. The Natural Capital Accounting Index (NCAI) which is used as the basis for one national indicator does not, at present, include the marine environment. A wider set of indicators, and the inclusion of the marine environment into the NCAI, were seen as a possible avenue for increasing the concern for different ES across policy and regulatory institutions (GOV04). Several interviewees highlighted that more work was being done on integrating the ES concept into terrestrial government, both in the form of the Natural Capital Accounting Index, and the establishment of a Payments for Ecosystem Services programme aimed at peatland

restoration, suggesting that marine governance may eventually ‘catch up’ (CON02 and AC19).

4.4.4.6 One framing amongst many

One respondent with significant familiarity with the policy making process highlighted how the ES concept was one framework amongst many, and that alternative framings may be more suited for attracting support for policy initiatives (GOV04). Other potential framings that were mentioned by interviewees were: addressing social deprivation and social wellbeing (AC19 and GOV04); ‘inclusive growth’ (GOV04), ‘community development/ protection’ (GOV015) or deprivation and underrepresentation; social wellbeing (GOV04); and ‘combatting climate change’ (GOV04). Although the ES concept were not seen as mutually exclusive to these framings, it was seen largely as an approach to trade off analysis that may be deployed within one of these wider frames (GOV14 and GOV04).

Others did see the concept as particularly helpful in mediating conflict between different sectors, as it increases the transparency of the trade-off as the basis for decision making (GOV03). Increased attempts to look holistically at the social and economic impacts of development was also seen as a trend in policy making that the ES concept can usefully contribute toward (GOV04). This had come to the fore in an experimental project done to look at ES from renewables and fisheries interactions named ‘CORPORATES’ (Scott et al., 2016) (AC19 and GOV06), in particular as a way of capturing the wider cultural benefits of different industries.

4.5 DISCUSSION

4.5.1 An idea worth exploring

While they did not express a presumption that adopting the ES concept would de facto be an improvement on the status quo, there was a view amongst many interviewees that it was an idea worth exploring. This finding matches that of Claret et al. (2018) who suggest that Scottish policy makers have become ES ‘literate’ in recent years. Unsurprisingly, the more recently a policy paper had been published, the more likely it is to be consistent with an ES approach – although that does not necessarily indicate uptake of the ES concept within the sector the policy relates to. While the concept is far from fully embedded within Scottish inshore governance, numerous attempts to experiment with the concept have been made. Several factors were identified that may have impacted on the success or failures of these attempts,

relating to both the existing institutional infrastructure and inherent difficulties in using the concept. Prevailing cultural norms and policy priorities have also impacted on the way in which the concept is being adopted. Below I discuss these dynamics in relation to the process of infrastructure formation for embedding the ES concept.

4.5.2 Relationship between the ES concept and existing institutions

In several uses identified, the concept is not well defined, and operates as an 'idea' with which people are experimenting and thinking through implications (uses 2, 5, 6). It is in these contexts that the ES concept can operate as a boundary object. For example, the ES working group at Marine Scotland (responsible for use 2) brought together staff from across the organisation with external experts. There was not necessarily a shared understanding of the ES concept, but it provided a structure for discussions. This matches similar findings where ES has acted to highlight shared interests and provide a shared language between academics and policy makers (Abson et al., 2014; Alonso Roldán et al., 2015). In other instances (use 4, and 7 in particular) use of the ES concept had shifted from representing a boundary object, towards the creation of specific infrastructure for integrating ES considerations.

Several factors can be identified as influencing the pattern of uptake of the ES concept. Some barriers to uptake exist in all institutional contexts, others relate to the form of existing institutions and there are also inherent aspects of the ES concept that make it more suited to certain contexts. The cross-contextual barriers identified match those described in existing literature (Matzdorf and Meyer, 2014; Saarikoski et al., 2018; Wilkinson et al., 2013). They include issues of data availability, valuation problems (especially regarding less tangible services) and the lack of a regulatory hook driving the use of the ES concept. Although these were mentioned in all institutional contexts, advances in institutionalisation are still observable in use 4 and 7. It is therefore necessary to consider the features of a particular institutional setting that influence level of uptake of the concept.

The most developed uses of the ES concept in this case study are within the context of marine planning (Use 1,2,3,4), particularly in regional planning (Use 4). Marine planning is relatively new in Scotland and emerged contemporaneously with the ES concept. This may explain the high number of attempts to adopt the ES concept in planning for two reasons. Firstly, actors engaged in developing Scotland's approach to marine planning had connections to academic institutions engaged in developing of the ES concept. Being part of this milieu would have increased familiarity and

awareness amongst these actors. One interviewee recalled attending a series of workshops on ES run by a UK based academic and cited this as a motivating factor for attempting to use the concept. Secondly, the lack of an existing process for developing marine plans made it easier to adopt an approach that integrates considerations of ES.

As discussed in the introduction, institutions typically exhibit path dependency, where the transition cost of deviating from an existing structure militates against the adoption of new ideas or approaches. Attempts to change course from the existing structure are likely to face barriers, in that actors who benefit from a given institutional arrangements will resist change. As discussed by da Conceição et al. (2015) and Mann et al. (2015), environmental concerns are often outweighed by more powerful government or private actors. Such forces can block efforts at integrating additional environmental concerns into institutions. In their review of 199 coastal ES assessment studies, Solé and Ariza (2019) identify power relations as a core explanatory variable in terms of access to ES, and suggest that power relations become a core part of ES assessments.

Institutional lock ins, in part due to entrenched interests, may explain the higher prevalence of the ES concept in a newer institutional context like marine planning. It was also suggested by many interviewees that planning was the most appropriate context for considering ES as it was inherently suited to addresses sector/ sector trade-offs and cumulative impacts. Here I see an interplay with the nature of the ES concept itself and potential institutional venues. Its implied holism, in attempting to consider all relevant benefits, requires that the potential institutional venue has the necessary scope to consider these benefits (Falk et al., 2018). It is worth noting that the key legal drivers behind River Basin Management Plans and Regional Marine Plans, the Water Framework Directive, the Marine Strategy Framework Directive and Marine Spatial Planning Directive respectively, provide similar scope for the consideration of a range of environmental benefits. Yet consideration of ES has been progressed in marine planning and not river basin management planning. Here, the argument regarding the novelty of institutional forms remains the most compelling explanatory factor.

The approach to Nature Conservation MPA designation in Scotland, though relatively new, is heavily modelled on the existing approach to the designation of European Marine sites. Key priority features (habitats or species) are identified and

sites are designated to protect these. A recent attempt to integrate ES as a criterion for selecting sites in the new round of designations under Scottish legislation was not carried forward, in part due to a lack of data. The filling of data gaps is driven largely by regulatory requirements and policy priorities, meaning that full assessments of MPA ES potential are unlikely. Similarly, those in the conservation sector are primarily concerned with ensuring the existing system of MPA designation, and the protection of priority sites outside of MPAs are considered. ES are therefore not seen as a replacement for existing conservation targets, but as a potential tool for increasingly arguments for conservation's biodiversity-focused objectives.

In the context of MPAs, there may also be aspects of the ES concept itself that reduce the likelihood of its integration into designation and management decisions. The existing institutional infrastructure for MPA designation requires a stable feature against which to justify designation and measure progress. ES, as processes themselves, cannot be easily captured within such a framework.

In fisheries regulation, there was minimal awareness of the ES concept, and discussions focused primarily on the ecosystem approach (Scott et al., 2018). This emphasis is driven in part by market forces. The desire to become MSC certified was mentioned by all representatives of this sector interviewed. Yet progress toward the integration of an ecosystem approach has been stalled by the stability of existing governance mechanisms. One interviewee clearly identified that the institutional infrastructure that exists around single stock level advice has made it difficult to integrate ecosystem modelling into the existing governance regime.

It is possible that the significant rupture of leaving the European Union will provide the policy space to rethink the Scottish approach to marine regulation (Matzdorf and Meyer, 2014). However, the entrenchment of institutions bred from the EU Directives means that this is not likely to be the case. It is more likely that if the ES concept is integrated at all, it will continue to be though incremental introduction or the layering of new institutions on top of old ones. Much of the institutional work on the ES concept has focused on the creation of new institutions, primarily PES schemes (Barton et al., 2017; Chapman et al., 2020; Grima et al., 2018; Meyer et al., 2018). To truly understand the impact of the concept, more attention needs to be paid to the "often mundane and piecemeal" way in which institutions typically change (Jespersen and Gallemore, 2018, p. 508). The integration of the ES concept

into every institutional context may not be necessary to ensure ES are effectively considered within the overall policy mix. However, the concept only being embedded into marine planning would mean it were only effectual if marine planning itself alters the behaviours of different industries and sectors, which is not guaranteed (Greenhill et al., 2020).

4.5.3 The impact of existing norms and policy priorities

In addition to the impact of path dependency and context specific barriers to the adoption of the ES concept. The pattern of uptake, and the shape the developing infrastructure is taking in Scotland, has been influenced by existing governance norms and policy priorities. Within marine governance in Scotland generally, there is a move toward more decentralised and participatory approaches to management. This is particularly pronounced on island communities, for example on the Shetland isles, which have a locally managed fishery. This can also be seen in the establishment of Inshore Fisheries Groups and the devolved regional approach to marine planning.

This trend is reflected also in the manner in which marine planning has developed in Scotland, being delivered through regional partnerships. Coupled with a general move towards decentralisation is a policy commitment in Scotland to protect and promote development in rural communities. These commitments have shaped the way that the ES concept is being institutionalised. The most developed methodologies are based at the regional, rather than national level, and emphasise a process of evidence gathering and validation from a range of sources, with input and oversight from the planning body. This epistemologically pluralistic approach demonstrates a symbiotic relationship between this particular institutional venue and the nature of the ES concept. The result is that methods and practices are being developed in particular localities that cannot necessarily be translated directly to other areas, even where a similar planning process is happening. This means that different areas of coastline have been assessed for ES provision to differing degrees and are covered by different levels of planning. Interviewees suggested that it was not yet clear when, or indeed if, the remaining marine regions would receive funding to undertake planning.

Another existing trend is a compulsion for economic growth. That economic growth is a key policy concern in Scotland is not a novel observation and is likely true of nearly every context in which the ES concept has yet been applied. However, as the

concept is an attempt to redress the balance in decision making towards non-economic considerations, it is worth examining the implications of this. The impacts are most apparent in the aquaculture sector. The evolution of regulation in the aquaculture sector has been driven in part by a stated government desire to grow the sector. Regulators and ministers are mindful not to add additional barriers to the expansion of the industry and have introduced several innovations to ensure growth is possible. This may explain why efforts to integrate ES considerations into River Basin Management Planning have not yet been carried forward (Use 5). The possibility of the ES concept working against economic imperatives was raised explicitly by one interviewee who commented, “people get nervous, because could you stop a development because of *sense of place* or *seascape?*” (AC19).

This unwillingness to confront economic interests may also explain why the ‘3-mile limit’ has not been reintroduced in inshore fisheries management, despite the recommendations of a Marine Scotland-commissioned report based on an ES approach (Use 8). This outcome would involve a significant transfer in benefit from inshore fishers to ‘consumers’ of other ES and likely from mobile gear fishers such as trawlers to static gear fishers such as creelers. This is not to suggest that such a transfer would necessarily be the right policy decision. Fishing is a vital industry in many parts of rural Scotland, and also a significant part of the cultural heritage of the coast. This does, however, reveal the tension that exists when an ES assessment indicates a policy move that would disadvantage a powerful economic actor.

The possibility of placing additional burdens on economic actors also raises the risk that these may be challenged in court. A number of interviewees in government regulators indicated that a need to avoid legal action was a key driver of how they gathered data and made decisions. This dynamic reinforces the status quo and militates against innovations. This does not just play out within economic sectors; conservation organisations too will seek to use deviation for legislative criteria as a case for legal action.

A final factor driving institutional development in inshore governance is the climate change agenda. This agenda shaped the Marine (Scotland) Act and the first draft of the NMP. The climate agenda is a direct example of how existing priorities shape the use of the ES concept. Attempts to consider ES as a criterion for selection of MPA sites were dropped in part due to lack of data (Use 6), however efforts to fill such data gaps have been uneven. Of the ES not related to commercial fish stocks,

the only ES to have seen significant research interest is carbon sequestration. Several research programmes have been established to understand ‘blue carbon’. At a UK level, a recent Government report on High Protected Marine Areas also uses the term ES but includes only blue carbon as an indicator to report against (Benyon et al., 2020). This exemplifies the adoption of ES to inform and legitimise an existing area of policy concern.

4.6 CONCLUDING REMARKS

A central contention of this chapter is that the integration of the ES concept into governance institutions is a process of institutional change. Adopting the concept requires modifying, replacing, or creating new institutional arrangements. As the ES concept is not a fixed thing, how it is interpreted and used is inevitably influenced by existing institutional arrangements specific to the context under study. Viewing adoption of the ES concept this way moves away from a binary conception of success or failure in any given context. Instead, it draws attention to the dynamic interplay between the concept and existing institution. It also makes clear the different barriers that specific institutional settings present, as well as the institutional work that is done by actors ‘on the ground’ to shape the uptake of the ES concept.

Through our case study we identified a number of general barriers to uptake including: the lack of reliable data; difficulty of deriving accurate valuations; the lack of regulatory or legislative drivers; legal defensibility of actions taken based on assessments of ES; the lack of any national performance indicator linked to ES; and competition between an ES framing and alternative approaches to policy formation. These barriers accord with findings in similar studies and highlight the difficulties of applying a novel concept to an existing array of institutions. Future attempts to adopt the concept may seek to directly address these barriers, however our case study showed that they do not block uptake in all contexts.

Though the above barriers were cited across institutional contexts, more progress at integration was made in some areas that others. New institutional forms, those dealing with whole geographical areas rather than distinct activities, and those that can accommodate a higher level of uncertainty and lower levels of precision are likely to provide more appropriate venues. Hence, as our study found, spatial planning likely provides the most viable institutional form for adoption of the ES

concept. Attempts to adopt the concept in the context of sectoral regulation or conservation policy have been less successful.

There was minimal consistency in precisely how the ES concept was defined between contexts. Though, the major contribution the concept was seen as making was in facilitating trade off analysis by explicating the interests of different stakeholders. Contrary to concerns in the ES literature regarding commodification, economic valuation was not central to many actors understanding of the primary purpose of the ES concept.

Finally, we were able to determine that existing norms and priorities are shaping the manner in which the ES concept is defined and integrated into environmental governance. The trend towards devolved decision making, participatory approaches to knowledge creation, and growing concern for climate change are all visible in how the ES concept is being deployed. As with many settings, the imperative of economic growth is also an overriding concern in inshore governance in Scotland. Unsurprisingly, no instances where the ES may imply a decreased in economic activity has it been carried forward.

This case study has demonstrated the value of approaching the question of ES adoption as a question of institutional change. Identifying more generalisable lessons to guide future efforts to integrate the ES concept into governance arrangements will rely on an increased number of in-depth case studies. Such case studies are increasingly appearing in the literature, this chapter suggest that a more explicit adoption of insights from institutional change literature may be off benefit for such studies in the future.

AFTERWORD

Thesis questions this chapter addresses

Q2. How does the ES concept interact with existing institutions when put into practice, and what are the implications competing tendencies inherent in the concept?

The institutionalisation of the ES concept in Scottish inshore governance is far from complete. However, even at this stage, it is possible to observe how existing institutions are shaping its uptake. Newer institutional forms are more likely to have

taken up the concept than more established institutions, potentially due to lock in effects and path dependencies. This points towards institutional layering as a likely mechanism by which the ES concept will be adopted. Certain elements of the ES concept, in particular its implied holism, also mean that the concept is seen as more suited toward governance institutions with a broad remit- such as planning. This suggests that understanding the horizontal and vertical interaction between different institutions is vital for understanding the overall impact of the ES concept (Saarikoski et al., 2018).

There were not clear cases in this case study where an overly reductive approach to the ES was being adopted. The most advanced use of the concept, in marine planning in Shetland, an approach to knowledge generation had been specifically designed to draw on diverse expertise. Indeed, the complexity of ES, and difficulty of measuring them, is seen as a barrier to the uptake of the concept in Scotland. The concerns regarding ES as a 'complexity blinder' appear ill founded in this context. However, a reductive interpretation of the concept can be seen in instances where valuation is attempted. The majority of uses of the ES concept identified did not attempt to value services and focused on the biophysical element of the ES concept. Where valuation had occurred, for example when assessing the impact of an MPA, valuations were based on established methodologies grounded in neoclassical techniques. These results were seen as having too great a range to be useful. There were no identified efforts to explicitly consider broad value types in ES assessments. This apparent tendency to default to established valuation approaches points to the need to direct efforts towards the design and institutionalisation of methods that capture a wider range of values.

Impact on my understanding of the ecosystem services concept

The primary insight I gained through this research regarding the ES concept was an understanding of its relative robustness. I began the research primarily interested in how existing institutions shaped the manner in which the ES concept is taken up. Through the course of the research it became apparent that features of the concept itself influence uptake. This can be seen in the way that it lends itself to consideration in certain institutional settings over others.

An additional insight was that similarly to survey respondents in Chapter 3, there was little interest amongst interviewees in market prices of ES. This observation accords with other research into the views of policy makers, suggesting that

concerns about the tendency of the ES concept to catalyse a process of commodification may be over stated (Ruckelshaus et al., 2013).

Relevance to the reductionist vs pluralist potentialities

This chapter revealed three things with regards to the ongoing debate in this thesis between the reductionist and pluralist potentialities in the ES concept.

First, there was very little interest in monetisation and market-based mechanisms. In the marine environment in Scotland there are no current efforts to establish new governance structures or policies specifically focused on ES. The precludes the possibility of establishing new payments based or market-based mechanisms. Most policy makers were looking to use the concept as a way to augment existing governance institutions, and monetary valuation was not prioritised. The concept was primarily seen as a way of highlighting multiple benefits for the sake of clarifying trade-offs.

Second, consideration of shared and cultural values still has relatively little integration. In most cases, uses of the ES concept focused on the biophysical element of ES. However, where values were considered, these were derived using tools from neoclassical economics. Chapter 3 identified the integration of social and cultural values into ES assessments as a key element of proper use of the concept. To date these discussions have not visibly penetrated policy design in Scotland.

Finally, it is not necessarily a reductionist interpretation of the ES concept that is a primary danger here. In this case study, the more apparent issue is how prevailing political and institutional structures can limit effectiveness of the ES concept simply by limiting uptake. The ES concept appears most suited for particular governance institutions. These are primarily participatory institutions with a broad focus, namely planning regimes. However, it has limited capacity to overcome existing embedded norms or to alter political priorities. Ultimately changing institutional rules requires actors to change their behaviours. Entrenched interests can resist any such changes if the benefit from, or even are accustomed to, the status quo. This highlights the fundamentally political nature of institutional change and attempts to alter how environmental benefits are directed. This suggests that future work on ES, particularly work on operationalisation, should engage with this issue directly. This is necessary both in descriptive studies, where power relations too often do not form

part of the analysis, but also prescriptive work that seeks to actively engage in institutional design.

5 ECOSYSTEM SERVICES AS A POST-NORMAL FIELD OF SCIENCE

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FOREWORD

Origin of chapter

Leaving behind larger scale discussions of institutional change, this paper 'zooms in' to the scale of individual ES assessments. This paper was sequentially the first the I worked on and represents my earliest attempt to think through the implications of a pluralist approach to ES research. My initial motivation was an exploration of the positive and normative entanglement implicit in the ES concept, and how this can be resolved through study design. At the time this paper was developed I still intended to undertake research into the South Arran MPA, and the methodologies I was exploring for this task helped provide the framework to think about this paper. One of my supervisors (Jasper Kenter) explicitly adopts a post-normal science approach in much of his research. A series of conversations therefore led me to the post-normal science literature as a way of conceptualising issues I was engaging with in the development of my methodology. Noticing the apparent suitability of a post-normal science approach for ES research, I undertook a literature review to identify if such an approach was common in the field. This chapter presents the findings of this review, along with an argument for a more explicit adopting of post-normal science in ES research.

This chapter links to previous chapters in the following ways. As discussed in Chapter 1, a pluralist understanding of the ES concept requires engagement with a range of academic disciplines and knowledge types. This sentiment was expressed by survey respondents in Chapter 3, who identified the importance of inter- and transdisciplinary approaches to ES research. This chapter responds to this challenge by proposing a framework to knowledge elicitation and validation capable of dealing with a multitude of knowledge types. Institutions capable of integrating multiple knowledge types share features with those suited to the elicitation of plural value types – in that they are necessarily participatory and deliberative. This chapter

therefore also links to observations in Chapter 4 regarding the current lack of valuation institutions capable of dealing with a plurality of value types.

Thesis questions this chapter addresses

Q1. What principles should guide the operationalisation of the ES concept?

Q3. How can assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

5.1 INTRODUCTION

As the concept of ecosystem services (ES) matures, more attention is focused on how it is applied in practice, how best to integrate ES knowledge into environmental governance (Guerry et al., 2015; Keune et al., 2013; Russel et al., 2016), and the role of ES researchers and other actors at the science-policy interface (Crouzat et al., 2017; Jax et al., 2018). We contribute to this dialogue by analysing the potential for the concept of post-normal science to provide a guiding framework for ES research. Post-normal science is an approach to knowledge generation focused on situations characterised by high uncertainty, that are value-laden and where decisions are urgent. While post-normal science has been considered retrospectively to describe developments in the field of ES (Fish et al., 2016d), thus far the applicability of post-normal science as a guiding framework for ES research has not been explicitly analysed. This paper addresses this gap in the following way. First, we introduce the concept of post-normal science, its descriptive and normative roles and how these may apply to ES research. We then briefly review the current use of a post-normal approach in ES research. Finally, we discuss benefits and challenges of post-normal ES assessment, and develop the idea of post-normal science as a potentially useful posture to guide ES researchers in this value-laden, mission orientated field (Keune et al., 2013; Schröter et al., 2014).

5.2 POST-NORMAL SCIENCE AND ITS RELATION TO ECOSYSTEM SERVICES

Post-normal science was initially developed by Silvio Funtowicz and Jerome Ravetz in the late 1980s and early 1990s as a response to perceived failures of the ‘normal’ mode of science (Funtowicz and Ravetz, 1991, 1993, 1994a). Normal science is understood as an expert led, problem solving approach of structured hypothesis

testing within an accepted analytical framework (Kuhn, 1962). The key differences between normal and post-normal science are summarised in Table 11. According to post-normal science, such an approach to science is not flawed per se, but simply insufficient for informing real world decisions (Funtowicz and Ravetz, 1993). Three key reasons exist for this, firstly, decision contexts tend to be characterised by high, potentially irreducible levels of uncertainty, leading to incomplete and potentially contested understandings (Funtowicz and Ravetz, 1994a). This includes both technical uncertainty, inherent in the available data, and epistemic uncertainty or "unknown unknowns" (Funtowicz and Strand, 2007). Secondly, decisions have as much to do with desired future states as they do with the processing of scientific information (Jardins, 1997; Norgaard et al., 2009). Finally, real world decision making does not allow for repeatable rounds of hypothesis testing as typically practiced in the normal mode of science. In such situations, the possibility arises for multiple, but equally legitimate understandings of the problem situation, suggesting the need for an alternative mode of evidence gathering. It is useful to understand post-normal science as playing both a descriptive and normative role (Strand, 2017). We will take both of these roles in turn and discuss first if ES research attends to post-normal situations, and secondly how the normative prescriptions of post-normal science might be applied to ES research.

As discussed by Crouzat et al. (2017), some ES research belongs to the realm of pure science and is totally disconnected from decision contexts. Here, the situation may well be characterised by high levels of uncertainty, but the relative disinterest from stakeholders and absence of political time pressure leads to this research being conducted through the methods of normal science. This work may be linked to ecological functioning behind ES, but be approached as a purely scientific question, detached from any decision situation. Yet ES is by conception a mission-orientated field, and is mostly carried out with the intention of informing policy or guiding decisions (Jacobs et al., 2013). These situations are likely to exhibit high uncertainty, be value-laden, and require urgent decisions. Uncertainty, due to the complex socio-ecological systems through which ES are produced; with non-linear, stochastic relationships and complex feedback loops leading to unanticipated responses to management changes (Chan et al., 2012a; Guerry et al., 2015; Sagoff, 2011; Waltner-Toews et al., 2003). Value-laden, because any question about the environment inevitably involves dimensions of how people feel they, and others, should live in the world, how people relate to the non-human world and the type of

world people want to live in (Irvine et al., 2016b; Jardins, 1997; Kenter, 2016a). Urgent, because environmental problems can arise unexpectedly and require swift responses. Also, ES management is often incorporated into policy cycles with finite decision points and time frames (Kenter et al., 2014b). Thus, the majority of ES research is likely to be conducted in 'post-normal' situations.

Table 11. Summary of main attributes of normal and post-normal science. Adapted from Strand (2017)

Feature	Normal	Post-normal
Descriptive		
Urgency	Research question not linked to impending decision/ political choice	Research question linked to impending decision/ political choice
Level of certainty	Situation is characterised by normal, statistically determinable levels of uncertainty	Situation is characterised by both technical and epistemic uncertainty leading to unpredictable system behaviour and the possibility of multiple legitimate perspectives
Conflict	Limited stakes held to the outcomes of the research and small chance of conflict	Substantial stakes are held within the study system, and substantial chance for conflict over values or knowledge claims is present
Normative		
Validation of knowledge	Through scientific peer review. Validity of knowledge is based on the views of other experts in the field	Undertaken by 'extended peer community' including experts from a range of disciplines as well as stakeholders and decision makers
Reductionism vs Holism	Individual components of wider socio-ecological system are primarily studied in isolation	Complex systems approach, aiming to understand environmental, social, economic, and political aspects of a situation (and interactions between these)
Knowledge types	Data generated through established scientific protocols	A plurality of different knowledge types is considered from diverse academic disciplines and local, indigenous, and traditional knowledges

In response to such situations, post-normal science reconstructs knowledge generation as a co-productive process between scientists and stakeholders which is intentionally critical, deliberative, and epistemologically pluralistic. This is achieved through the inclusion of 'extended facts' and scrutiny from an 'extended peer community'. Extended facts include multiple types of knowledge about a situation that can contribute towards a more holistic understanding of the complex socio-ecological system (Aslaksen et al., 2013; Bremer, 2014; Ravetz, 2011). This

includes local and traditional knowledge, as well as the recognition of academic disciplines that may previously have been neglected as legitimate lines of evidence in environmental decision making. Importantly, this pluralistic outlook regarding legitimate epistemologies does not equate to relativism, where all knowledge claims are considered equally valid. It is necessary to recognise that multiple, honest knowledge claims can co-exist, and establish a process to eliminate erroneous or dishonest claims to knowledge (Funtowicz and Ravetz, 1994b).

This validation is achieved in part through the creation of extended peer communities. These can take various forms, however a common feature is the inclusion of both experts and non-experts who use their respective knowledge and expertise to evaluate policy proposals, including their scientific and non-scientific evidence base (Dankel et al., 2012; Funtowicz and Strand, 2007; Hisschemöller et al., 2001). This shift in the knowledge generation is intended to serve the dual purpose of collating diffuse knowledge about a problem situation to improve the quality of decisions, as well as democratising decision making and avoiding the hegemony of any one worldview or normative position (Funtowicz and Ravetz, 1993).

Whilst post-normal science questions the capacity of normal science to usefully inform decision making in value-laden, uncertain contexts, it does not reject its ability to create knowledge regarding relatively simple phenomena (Spash, 2015). We therefore follow Kay et al. (1999) and Spash (2015) in suggesting that post-normal science can be seen to rest on a realist ontology akin to complex systems theory. That is, there is a reality ‘out there’ that behaves as clusters of semi-stable system states that maintain themselves through positive and negative feedback loops but are prone to reconfiguration under certain conditions (Berkes and Folke, 1998; Folke et al., 2016; Kay et al., 1999). This position is consistent with early work from Funtowicz and Ravetz, where they themselves develop the idea of emergent complex systems as the philosophical basis of post-normal science (Funtowicz and Ravetz, 1994b).

Building upon this ontological foundation, post-normal science allows for a plurality of epistemologies through the inclusion of extended facts. The legitimacy and relevance of any single epistemological position then becomes a matter of societal debate, necessitating the inclusion of an extended peer community. In accordance with this critical realist perspective, we consider that post-normal science has three

broad, complimentary normative prescriptions: 1) the adoption of a complex systems perspective, 2) engagement with a plurality of epistemologies and 3) a quality assurance process based on extended peer review. We will briefly discuss, with the use of examples, how ES research may adopt each of these requirements.

5.2.1 Complex systems approach

Early conceptual frameworks of ES production, such as the cascade model (Haines-Young, 2011), have been criticised for oversimplifying the complex socio-ecological interactions that underpin ES (Costanza et al., 2017; La Notte et al., 2017). Whether this is a fair criticism of the cascade model is a matter for debate (Potschin and Haines-Young, 2011), however it is true that recent conceptual frameworks seek to more explicitly represent systems interactions (e.g. Costanza et al., 2017; Díaz et al., 2015). Indeed a complex systems perspectives might be said to be truer to the origins of the ES concept, given its foundations in the work of systems ecologists such as H. T. Odum (Dempsey and Robertson, 2012; Odum, 1971).

An understanding of ES as emerging from complex socio-ecological systems can be incorporated into ES assessments in various ways. For example Villegas-Palacio et al. (2016) suggest beginning an ES assessment by undertaking an analysis of the physical, biotic, economic, cultural and political systems in the study site. This type of scoping exercise matches recommendations from a recent paper on ES best practice from the EU OpenNESS project (Jax et al., 2018). Other approaches to integrating systems dynamics into ES assessments involve such tools as causal loop diagrams; graphical schematics composed of nodes, connections and feedbacks within a system. These can be left as graphical representations, or used as the basis for computational modelling (Kenter, 2016b; Lopes and Videira, 2015).

5.2.2 Epistemological pluralism

There is a dual logic to adopting a stance of epistemological pluralism. Firstly, ES researchers may seek to gain a better understanding of social and natural elements of the ES being studied by drawing upon a range of academic disciplines, or through incorporation of traditional, lay, or local knowledge. For example, Daw et al. (2015), demonstrate how scientific fisheries data can be combined with local, place based knowledge on social and economic dynamics to build a shared understanding of the socio-ecological system underpinning the delivery of coastal ES. Within this additive logic, non-scientific knowledge is being used to illuminate parts of the socio-ecological system that are not visible in the available scientific data.

The second reason to acknowledge the existence of plural epistemologies is their role in creating situations of divergent understandings within contexts of high uncertainty. Disagreements in post-normal situations may not be due to misunderstanding or dishonesty, but the result of separate interpretations of a situation based on different epistemological or even normative stances. Indeed, many core arguments over the ES concept itself result from fundamentally different philosophies of knowledge (Barnaud and Antona, 2014; Schröter et al., 2014). Increasingly, the ES concept is viewed as amorphous enough to accommodate a wide range of knowledge perspectives (Braat, 2018). The IPBES (The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) framework, centred on 'nature's contributions to people', also seeks to accommodate diverse epistemologies (Díaz et al., 2018), although some argue that the IPBES terminology still harbours implicit epistemic biases (Kenter, 2018). Regardless of the degree of epistemic inclusiveness at a conceptual level, epistemological differences cannot be dismissed at the level of individual assessments, where it will often be the case that conflicting knowledge claims exist.

5.2.3 Extended peer review

Many ES studies include stakeholder contribution and participation at different stages of the process (Dick et al., 2018; Ruckelshaus et al., 2013). For example, in Liquete et al. (2016)'s valuation of nature-based solutions for water pollution control, early engagement with local stakeholders allowed them to co-design assessment criteria and indicators. Although composition of stakeholder groups and their exact role varies, early engagement with a wide range of actors is increasingly considered best practice in ES study design (Jacobs et al., 2015; Jax et al., 2018; Ruckelshaus et al., 2013). From a post-normal science perspective, it is important that stakeholder groups do not simply provide information to researchers. These groups must also have ownership of the process, including oversight of the contributions by scientists and awareness of assumptions and framings underpinning academic work.

From the perspective of post-normal science, it is the role of the extended peer community to counteract potential biases and unstated assumptions that may arise due to; (1) the part of the system that is being focused upon; (2) the perceived legitimacy of different knowledge types; and (3) implicit epistemological and ontological assumptions underpinning specific methodologies (Funtowicz and

Strand, 2007; Hockley, 2014; Jasanoff, 1996; Kull et al., 2015). With reference to case studies globally, Kull et al. (2015) in particular demonstrate how the scale, definitions and assessment methods used in ES assessments can be highly political decisions.

The above three elements of post-normal science can be seen as mutually enforcing. Multiple perspectives may exist, and multiple knowledge types are required *because* of the uncertainty inherent in complex systems. Oversight from an extended peer community is needed *because* of the possibility of multiple legitimate perspectives and potential for powerful actors to enforce their world view. As we shall discuss below, it is the internal consistency of these individual elements that gives post-normal science its value as a general framework for developing specific methodologies in ES assessment.

5.3 IS THE ECOSYSTEM SERVICES FIELD CURRENTLY POST-NORMAL?

Thus far, we have argued that post-normal science appears appropriate to the majority of ES research situations, and we have described key attributes of post-normal science and exemplified how they apply to the study of ES. However, it is unclear to what degree the ES field as a whole is characterised by these features. To answer this question, we present the findings of a focused literature review that aimed to assess how post-normal science is currently being used in the ES field.

5.4 METHOD

Scopus and Web of Science (WoS) were selected as databases for a literature search. An initial search for literature that explicitly referenced post-normal science and ES yielded few results (WoS= 9, Scopus= 4). (Search string: (“post-normal science” OR ”post normal science”) AND (“ecosystem service*”)). This confirmed our initial expectations that explicit consideration of post-normal science is highly uncommon within the ES field.

To identify further work in the field of ES that draws from post-normal science, we then performed a search for ES literature that cited key foundational texts in the field of post-normal science. We assumed that referencing of one of these texts indicated that the authors were aware of the concept of post-normal science, and that this may have informed their approach to the study of ES. To identify source documents, we performed a search for publications by Funtowicz and Ravetz from the years

1990 to 1995 (deemed to be the years in which the concept of post-normal science was established). We selected any publication that advanced the concept of post-normal science and had approximately 100 citations or more in either database. These publications were taken as being the most likely to be cited in reference to post-normal science in ES literature. These included four articles and two book chapters which have been cited collectively 2096 times on WoS and 2131 times on Scopus (Funtowicz and Ravetz, 1994a, 1994b, 1994c, 1993, 1992, 1991).

The papers that cited these articles were next filtered down using the search string: "ecosystem service*". This, together with the initial search results, yielded a total of 94 peer reviewed papers. The abstracts of these articles were then scanned, and they were selected for further consideration if they: 1) made a conceptual contribution to the design of ES assessment, and/ or 2) presented the results of an empirical study which utilised an ES framework. Where we were unsure, the full text was considered before a judgement was made. Borderline cases not included in the final review can be found in the supplementary material, with an explanation of why they were excluded.[10]

A table was created to record: 1) if studies were conceptual and/or contained a significant empirical component, 2) the context in which the study authors had discussed post-normal science, 3) and if this framing explicitly informed their study. It was deemed that the post-normality of the situation (descriptive element) was difficult to judge without further knowledge of the study sites (see Table 11 above). Instead we used simple descriptors to record the relationship of the study to the science-policy interface, these were: i) 'pure science' (no stated intention to influence decision making), ii) 'action orientated' (stated intention to influence decision making), iii) 'linked to policy' (formally linked to decision or policy process) or iv) 'embedded' (stakeholders and decision makers are actively engaged in the research process). The assumption was that any study which was not classified as pure science may potentially be a post-normal situation. In addition, the presence of normative attributes (epistemological pluralism, extended peer community, and complex systems approach) were also recorded for empirical studies. It is noted that these are ultimately subjective judgements based on our reading of these papers,

[10] Supplementary material available at: https://www.sciencedirect.com/science/article/pii/S2212041617305557?via%3Dihub

and a short justification for each decision can be found along with a full version of our recording table in Appendix I in the Online Supplementary Material.[11]

5.5 RESULTS

A total of 31 studies matched the inclusion criteria and were reviewed. Of these, 17 were largely conceptual and the other 14 contained detail of empirical assessments of ES. It is worth noting that these identified 31 studies referencing post-normal science compare to approximately 3000 papers published on ES in 2016 alone (McDonough et al., 2017). These 31 papers appeared in 19 different journals, most with one article, except for 'Ecological Economics' with eight, 'Ecosystem Services' with five and 'Regional Environmental Change' with two. The earliest paper found was from 2003 (Chiesura and De Groot, 2003). As shown in Figure 20, since 2014 there has been an increase in interest in post-normal science in the field, however this could also be an artefact of there being more ES studies published overall in these years.

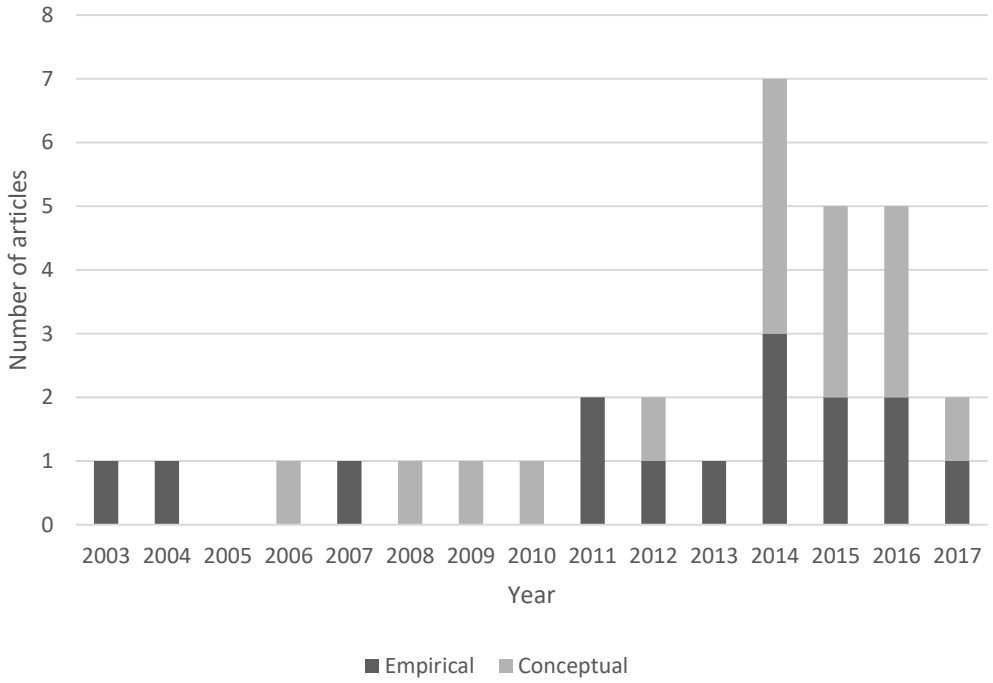

Figure 20. Number of publications over time that met our search criteria. Showing both conceptual papers, and papers with a significant empirical component

[11] Ibid.

Although other studies appear to have been influenced by post-normal science, only two explicitly stated that they were taking a post-normal science perspective. The first was a 2011 study published in Ecological Economics which used a participatory modelling approach to study ES trade-offs in the context of Integrated Coastal Zone Management (ICZM) for the Seine estuary (Cordier et al., 2011). The second was a 2014 conceptual paper comparing instrumental and deliberative paradigms for the assessment of cultural ES, also published in Ecological Economics (Raymond et al., 2014). In other papers, it was common for post-normal science to be only briefly mentioned (or a post-normal science paper to be cited) in the discussion or conclusion section. As is shown in Figure 21, this was often in relation to uncertainty, to dealing with multiple value types or as a general idea akin to increasing participation.

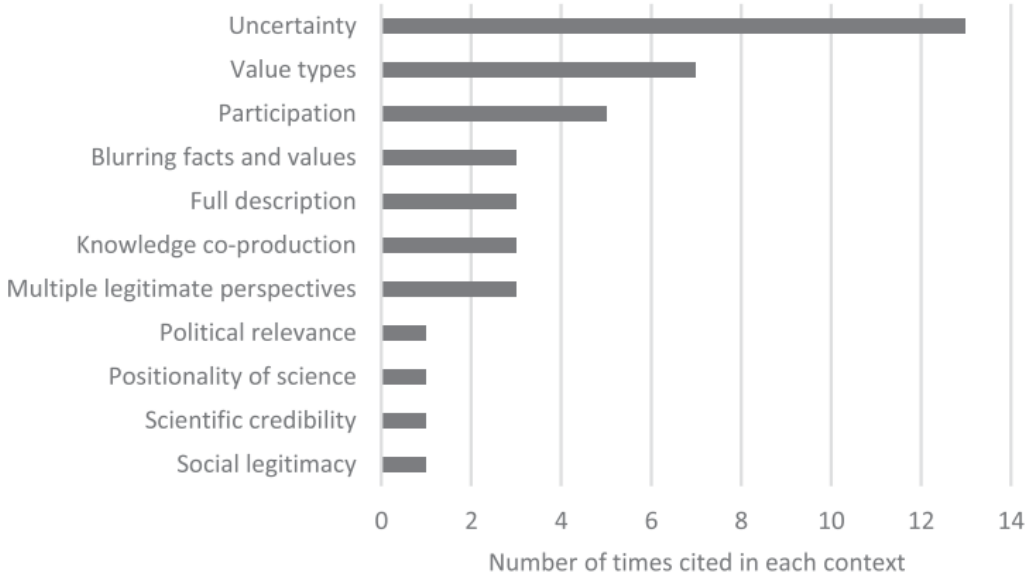

Figure 21. Contexts where post-normal science was mentioned or one of the seed texts was cited in terms of publication count

Of the empirical papers, none were considered to be ‘pure science’, eight were recorded as ‘action orientated’, one as ‘policy linked’, and five as ‘embedded’. All papers categorised as embedded, exhibited at least two normative elements of post-normal science, with three of the five exhibiting all three elements (Figure 22). All three of the studies that did not adopt any element of post-normal science were classified as action orientated.

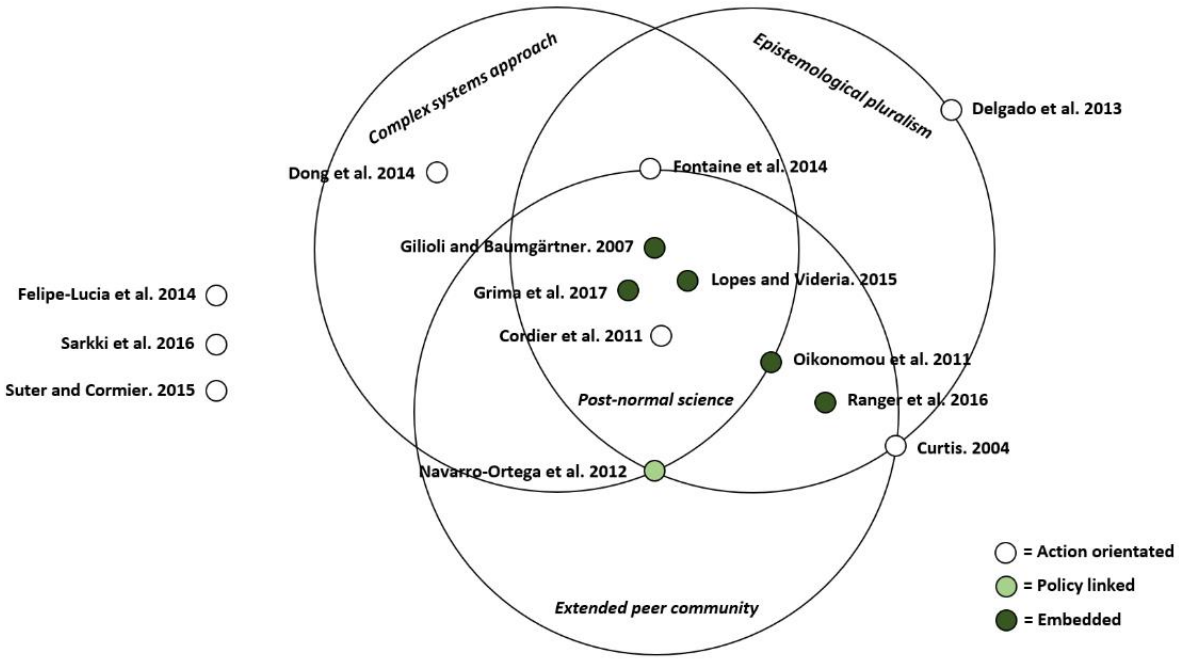

Figure 22. Venn diagram showing the elements of post-normal science present in each empirical study. Studies are colour coded depending on their relation to the science-policy interface. Exact distances between studies on the diagram are arbitrary, their position

5.6 POST-NORMAL SCIENCE AS A SCIENTIFIC POSTURE IN ECOSYSTEM SERVICES RESEARCH

Our review indicates that post-normal science is not a common framing in ES literature and research. Aspects of post-normal science did emerge however, and several studies were identified that, although not framed around post-normal science, could be described as such (Gilioli and Baumgärtner, 2007; Grima et al., 2017; Lopes and Videira, 2015). These studies tended to be more integrated in decision making or policy settings, supporting the applicability of post-normal science to ES assessments in decision making contexts. We acknowledge that our review is limited to studies with direct reference to foundational post-normal science literature, and we are therefore not able to comment on the extent to which elements of post-normal science appear in the ES field under different guises.

The reviewed papers reflect a number of threads that have received attention in recent ES publications; including questions around working with uncertainty,

participation and knowledge validation, and value plurality (e.g. Carmen et al., 2018; Hamel and Bryant, 2017; Pascual et al., 2017). In this final section, we will discuss the potential contribution of post-normal science to these threads, and associated challenges of such an approach, before concluding on a way forward for post-normal science as a *posture* in the ES field.

5.6.1 Uncertainty

Discussion of uncertainty in ES assessment was the most common context in which post-normal science was mentioned. Attention to uncertainty within ES assessments is growing, with a recent paper outlining practical approaches to undertaking uncertainty analysis in ES modelling (Hamel and Bryant, 2017). Although this paper acknowledges the presence of qualitative uncertainty and 'recognised ignorance', it primarily provides guidance on best practice in using ES models, especially when dealing with a number of integrated biophysical and economic models. These approaches are useful for recognising and characterising technical uncertainty within ES assessments yet need to be complemented by a recognition of epistemic uncertainty. Models have limited capacity to predict system behaviour that has not previously appeared, and may be entirely blind to aspects of the total system (Vatn, 2009). It is within this context of radical uncertainty, or indeterminacy, that some studies raised the potential of adopting insights from post-normal science (Heydinger, 2016; Navarro-Ortega et al., 2012; Ranger et al., 2016; Spangenberg et al., 2015).

Post-normal science aims to reduce epistemic uncertainty by illuminating larger parts of the whole socio-ecological system, therefore reducing the risk of completely unexpected outcomes from any subsequent intervention. Additionally, by defining system boundaries more explicitly, it may become clearer where residual epistemic uncertainty is likely to lie. This rationality for including extended facts was prevalent in our review, see for example Oikonomou et al. (2011) or Navarro-Ortega et al. (2012).

How such forms of knowledge are conceptualised and integrated varied between studies. Spangenberg et al. (2015) states that stakeholders hold knowledge of social structures, such as institutions, cultural and religious rules, but there is no suggestion of the need to formally collect these data. This is in line with more recent work on integrated valuation that recommends developing an understanding of the socio-ecological context to inform study design, yet does not suggest the need to

consider system dynamics per se (Mederly et al., 2016; Villegas-Palacio et al., 2016). Alternatively, other studies explicitly sought to understand system dynamics through the participatory creation of causal loop diagrams (Lopes and Videira, 2015).

One study attempted to integrate stakeholder knowledge of system dynamics into their computational modelling (Cordier et al., 2011). Yet such an approach has its drawbacks. As Funtowicz & Strand (2007) suggest, a trade-off exists in dealing with the two types of uncertainty. Where there is a focus on quantitative data with a high level of technical certainty, information relating to parts of the system that are less amenable to such levels of certainty, such as social dimensions, are omitted. Here, there is likely to remain higher levels of epistemic uncertainty and a greater likelihood that significant elements of the system are not accounted for. Conversely, including such information will invariably lower the level of technical certainty that is achievable. Indeed Cordier et al. (2011) suggest that adopting a holistic approach such as theirs can make it very challenging to accurately predict future states.

In sum, post-normal science seeks to reduce epistemic uncertainty in decision making through the inclusion of extended facts, going beyond the obviously quantifiable. Studies in our review attempted this in a number of ways, however a trade-off must be made when attempting to address both epistemic and technical uncertainty. This point is captured by Kull et al. (2015) in their example of a Madagascan study linking carbon offset payments to water quality benefits. They cite a study that achieves a high level of technical certainty for the small number of ES in question, but point out that this study is totally blind to other ES that may be impacted by the offset scheme being supported by its findings.

Much work in post-normal science approaches accurate predictions about the future with caution, and seeks instead to understand magnitude and direction of change at a broader system level (Kenter, 2016b). Whilst this may be appropriate for some situations, the management of many provisioning and regulating ES, such as fisheries and water quality, often requires a far higher level of technical certainty. Clearly such contextual considerations will play a role in the design of an ES assessment. The value of adopting a post-normal science posture is that it focuses attention on the different types of uncertainty present in a research situation. This in turn informs the selection of knowledge types that it is necessary to engage with,

and the trade-off that must be made between technical precision and whole system visibility.

5.6.2 Participation and knowledge validation

The participation of non-academics in research was another recurring theme across the papers reviewed. Nine of the empirical studies had some degree of stakeholder oversight in the research process, and five studies referenced post-normal science literature in the context of needing to increase stakeholder participation. Stakeholder input into basic elements of study design was the most common type of involvement in studies we reviewed. However, to be considered an extended peer community, stakeholders must not be passive information providers, but must also act as arbiters of legitimate knowledge claims within the research process. A number of studies reviewed did seek to ensure that stakeholders had oversight of the generation of scientific evidence.

The need for such oversight is captured by De La Vega-Leinert et al. (2008) when they discuss the politicisation of models in policy, and expert guesses and value judgements that often guide the modelling process. Similarly, in the context of the planned German National Ecosystem Assessment, Albert et al. (2017) suggest that different actors should come together to define what is considered as reliable evidence. However, this becomes increasingly problematic as more complex techniques are adopted. The single empirical study in our review that explicitly took a post-normal approach lamented the issue of 'black boxing', caused by the translation of their participatory model into computational form (Cordier et al., 2011). Fontaine et al. (2014, p.300) capture the issue well when they state: "The challenge is thus to make this process-based calculation transparent enough for decision-makers without jeopardising the scientific precision of the simulator". Even among relatively well informed stakeholders, it can take substantial time to reach the level of understanding needed to usefully comment on quantitative modelling approaches (Cordier et al., 2011), and stakeholders may not be willing to commit the time and motivation.

Ensuring oversight from an extended peer community requires careful consideration of how this will be done, and the time and training requirements that this may raise. Post-normal science does not necessarily intend complete, in-depth oversight of each step of the research process by the extended peer review community. Rather, adopting the posture of post-normal science creates a realisation that in complex

systems, all knowledge is uncertain and the boundary between values and facts is fuzzy. This reflexive position makes issues such as politicisation and black boxing explicit, brings issues of oversight to the fore and ensures that knowledge claims, even those of expert scientists, are not taken for granted.

5.6.3 Value plurality

A third thread running through the identified papers is the existence of different types of values at play in ES assessments. Within reviewed studies, values were discussed as a source of uncertainty (Dong et al., 2014; Fontaine et al., 2014) that required a range of different approaches to generate an estimate of (Curtis, 2004; Ranger et al., 2016; Spangenberg et al., 2014). Although some studies saw a role for monetary valuation (Curtis, 2004; Suter and Cormier, 2015), many suggested that this was problematic on its own (Felipe-Lucia et al., 2014; Spangenberg and Settele, 2010; Suter and Cormier, 2015). Values were also considered as intimately entwined with participation, with the inclusivity and rigour of participation strongly influencing the degree to which value plurality is realised (Ranger et al., 2016). More broadly, it was recognised that institutional structures play a significant role in how values were expressed (Raymond et al., 2014; Sarkki et al., 2016; Spash and Vatn, 2006; Vatn, 2009).

Vatn (2009) identifies institutional arrangements geared towards social learning and communicative action as most suitable for ES due to the complex nature of the goods and services in question, and the potential incommensurability of value types involved. It is important that sufficient space is given to the consideration of the nature of the good as well as underlying transcendental values – the broad principles and life goals that people use to guide their valuation of particulars (Kenter et al. 2015; Raymond and Kenter, 2016) - through a rigorous process of deliberative value formation (Kenter et al., 2016c; Raymond and Kenter, 2016a). The contribution of post-normal science in this context is clear. A post-normal science process is specifically designed to allow for participant learning and the sharing and debating of different normative positions and value types. Indeed, much of the theoretical work on environmental values in relation to ES comes from the field of ecological economics, itself regularly identified as a post-normal science (Castro e Silva and Teixeira, 2011; Funtowicz and Ravetz, 1994a; Kenter et al., 2016c, 2015).

5.6.4 A post-normal science posture in ES research?

It is thus evident that aspects of post-normal science exist in ES literature under different guises. However, as we have seen, application of post-normal science to ES assessment generates both promises and challenges surrounding uncertainty, participation and knowledge integration, and value plurality. To resolve these tensions different degrees of 'post-normality' may be appropriate in different contexts. Issues arise due to the necessary trade-off between technical and epistemic uncertainty, the capacity of stakeholders to have oversight over highly technical scientific work and the difficultly of ensuring the right mix of stakeholders are effectively engaged in the process throughout. These issues require consideration in the precise design of an ES assessment, in light of the institutional and political setting in which it is being conducted.

For this reason, rather than prescribing a single and post-normal science approach, we advocate the promotion of a flexible but explicitly post-normal posture within policy and action-orientated ES research. To assist with this, we have developed a short list of questions that should be considered when approaching ES research in such a way (Figure 23). Importantly, the benefits of the post-normal approach are not derived from the application of individual aspects. The three identified elements of post-normal science are mutually enforcing, and together provide a coherent framework with broad applicability, a consistent philosophical underpinning, and in-built reflexivity. We conclude this paper with a discussion of these key benefits.

Broad applicability

The design and composition of an extended peer community and the nature of extended facts sought are not specified by post-normal science. What is specified is their purpose: to bring the best available information to bear on complex, normatively loaded questions in a deliberative democratic manner. The rationale of the broad elements of post-normal science is both normative, in that knowledge claims are linked to normative positions, and instrumental in that multiple perspectives can decrease epistemic uncertainty. Thus, post-normal science is specific and prescriptive enough to assist in ES study design, yet broad enough to be applicable in a wide range of cases.

Consistent philosophical underpinning

The need to consider with a wide range of knowledges is recognised in much ES literature (Carmen et al., 2018; Dick et al., 2018; Haines-Young, 2011; Mederly et al., 2016); yet to engage with knowledge claims in a consistent manner, it is necessary to start from a clear philosophical position. In combining the realist ontology of complex systems theory with a social-constructivist account of epistemology, post-normal science offers a coherent framework for understanding multiple competing knowledge claims that neither collapses into relativism, nor requires arbitrary criteria of 'right' and 'wrong'.

In-built reflexivity

ES is an inherently mission-orientated field, and the work and actions of researchers have real world consequences at micro and macro scales. This reality means that ES researchers must be highly cognizant of their role at the science-policy interface (Crouzat et al., 2017). Acknowledgement of complexity and radical uncertainty, and the resulting blurring of facts and values, forces reflexion on one's own positionality within research contexts. Adopting such a reflexive position, and addressing assumptions and biases in the research process, is key to ensuring that ES is not the blinkering concept that some (e.g. Norgaard, 2010; Spangenberg and Settele, 2010) are concerned it has become.

In conclusion, we have clearly established that there is no widespread recognition of post-normal science within ES research, but aspects of post-normality can be identified that resonate with broader developments in ES research around managing uncertainty, participation and knowledge validation, and value plurality. The picture that emerges from our research is one in which post-normal science and ES can be co-informing and synergistic. By taking a completer and more explicit, but also flexible post-normal posture, future ES research can benefit from the philosophically consistent but broad and reflexive framework that post-normal science offers. At the same time, the inherent action-orientated nature of ES means that much ES research demonstrates post-normal science in action, and the post-normal science community could learn much from attempts to apply its principles in real-life situations in this field.

Assessing the situation

- Are there high levels of uncertainty?
- Are there many stakeholders, and do they hold conflicting interests?
- Is this research likely to be used to inform policy or other particular decision making process?

If *yes* to all of the above, then a post-normal approach might be appropriate:

Process oversight

- Which stakeholders should be included and when?
- What format will engagement with and participation of stakeholders take?
- What is the degree to which stakeholders have the capacity to understand and maintain oversight of different elements of the process?
- What training / capacity building is necessary to ensure stakeholders can meaningfully contribute and maintain oversight?
- Can the process be adjusted to enhance participation? What are the constraints (time, resources, other)?

Dealing with multiple knowledge claims

- What knowledge is pertinent to this context and how / with whom is it held?
- How will different knowledge claims be validated?
- How will different knowledge types be integrated?
- What differences in understanding might exist, and how will these be dealt with?
- What knowledge will be excluded (e.g. due to constraints in scope, time, resources, capacity)?
- What assumptions are made when answering these questions; how can they be made transparent to all involved?

Managing uncertainty

- What level of technical and epistemic uncertainty exist?
- How are these types of uncertainty addressed within the process?
- What trade-offs result from the chosen research design?
- How can uncertainty and trade-offs be made transparent to all involved?

Figure 23. Suggested questions to consider when adopting a post-normal science posture to ES research. It is the intention that these induce reflexion, and are not a prescriptive list of how to conduct ES research.

AFTERWORD

Thesis questions this chapter addresses

Q1. What principles should guide the operationalisation of the ES concept?
Q3. How can assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

This paper responds to both Q1 and Q3 by arguing for the adoption of a post-normal science approach to ES research and assessment. Such an approach can help to operationalise the principles of inter-and transdisciplinarity and the recognition of social and cultural values identified as key principles in Chapter 3.

As identified in 4, the ES concept is particularly suited to devolved and participatory planning regimes. Post-normal science offers a framework to approach the assessment and valuation of ES in such governance settings. Post-normal science should therefore be viewed not just as a methodological consideration, but as a principle of institutional design.

Impact on my understanding of the ES concept

This study primarily assisted in developing a stable philosophical basis for thinking about the ES concept. This was through both the introduction of an explicit critical realist perspective, based on an ontology of complex systems theory. This critical realist perspective is necessary to stop the potential for a decent into relativism that can result from a move towards epistemological pluralism. Viewing the ES concept through the lens of complex systems theory also helped to clarify that way in which the concept acts as both a guiding frame, but also potentially a blinder. The ES concept captures only some of the complexity of the system it seeks to describe, and in doing so foregrounds certain aspects and elements at the expense of others.

Relevance to reductionist vs pluralist potentialities

Approaching ES research from a post-normal science perspective has implications for both the opportunities and dangers associated with the ES concept.

With regards to values and valuation. The post-normal science approach is particularly suited to the consideration of a plurality of value types. Deliberation is central to the post-normal science approach, and also a key feature of valuation

methods aimed at the elicitation of plural value types. By opening up the process of knowledge creation to a range of epistemic views and by expanding the legitimation process, post-normal science also reduces the possibility of particular framings and worldviews implicitly shaping outcomes.

Commodification requires that conceptual transformation of a specific good or service into generality – an abstract concept where any one unit of it is identical to the next. It is this type of logic that allows for valuation approaches such as benefit transfer, which can lead the way to commodification in the form of offset schemes or offset credits. This process requires an approach to appraisal that deemphasises the contextual specificity of the good or service, such that it can be conceptually removed from its context. It reduces the types of legitimate epistemological claims and relies on a reductionist conception of uncertainty and risk. It requires an approach to assessment that is the exact opposite of a post-normal science approach. Adopting a post-normal science approach to the study of ES therefore removes the possibility of disentangling the identified services from their context in a manner that makes them appropriable and commodifiable.

The notion of ES as a complexity blinder is also substantially overcome through a post-normal science approach. The explicit evocation of a complex systems framing, and the consideration of epistemological uncertainty is the precise opposite of the view of ES as a simplistic stock-flow relationship. Furthermore, the approach brings to bear the widest possible range of knowledge and evidence for understanding the complex systems underpinning ES, both in terms of the underlying biophysical processes and the wider socio-ecological system.

6 INTEGRATING PLURAL VALUES INTO MARINE PLANNING: APPLICATION OF A DELIBERATIVE DEMOCRATIC MONETARY VALUATION APPROACH

FOREWORD

Origin of chapter

This chapter brings together themes from previous chapters to inform the development of an approach to ES valuation. This paper came about through my work in the Clyde and further thinking specifically about how to integrate plural and cultural values into governance institutions. The approach directly responds the desire for the integration of social and cultural values identified in Chapter 3. It builds on findings from Chapter 4 in that it takes the example of marine planning in Scotland as a participatory governance institution suited to the application of an ES approach. It follows from Chapter 5 in that it adopts an explicitly post-normal science approach to the study.

The study itself does not adopt the language of ES explicitly. I adapted the approach to fit the existing work that has been undertaken by the CMPP. This was to make it congruent with other work feeding into the regional marine plan, and to allow me to draw upon their existing research and materials. The CMPP has produced a series of topic cards on different social, economic, and environmental attributes of the Clyde. These topic cards and associated indicators were taken as the basis for this study. Many of these indictors match directly with ES and the CMPP explicitly considered ES when designing and gathering data on the indicators. Therefore, although the language of ES is not used in this study, the concept none the less sits behind the methodology and directly informed its design.

This study was developed along with my supervisor Jasper Kenter and was structured to also collect data for an ongoing project into the integration of cultural heritage into marine planning. I was assisted in facilitating the workshops by Jasper Kenter and Elaine Azzopardi.

Thesis questions this chapter addresses

Q3. How can assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

6.1 INTRODUCTION

Understanding the social value and distributional impacts of alternative policy options is a core component of good policy making (Costanza et al., 2014; Jacobs et al., 2016; Lienhoop et al., 2015). Although not new, assessment of social values of the environment has received increased attention since the emergence of the ES concept (Chan et al., 2012b, 2012a; Costanza et al., 2017; Irvine et al., 2016b; Kenter et al., 2016d; Millennium Ecosystem Assessment, 2005; Orchard-Webb et al., 2016; TEEB, 2010; Vargas et al., 2017).

There is now a wealth of both theoretical and empirical literature on environmental valuation and attention is beginning to focus on the impact valuations have on decision making (Costanza et al., 2017; Phelps et al., 2017; Russel et al., 2016). Suggested factors influencing the impact of environmental valuation include the perceived legitimacy of different valuation approaches (Lienhoop et al., 2015). For example, conventional stated preference approaches have been criticised on both ethical and conceptual grounds (Kenter, 2017; Lo and Spash, 2013), they remain contentious and appear to only rarely inform actual decisions (Schläpfer, 2016). A number of studies have explored the application of deliberative monetary valuation (DMV) to overcome concerns with conventional stated preferences approaches. DMV can not only address some of the conceptual issues raised with stated preferences, but also repositions valuation in the policy making process. Instead of valuation being used to extract knowledge about preferences to feed into a technocratic tool such as Cost Benefit Analysis, DMV allows valuation to be embedded within decision making institutions. Such embedding may help to improve the perceived legitimacy of valuation and fit valuation into the wider deliberative-turn within environmental governance (Dryzek, 2000; Rodela, 2012).

DMV takes many forms, with some representing only a limited departure from stated preferences. These forms can be loosely positioned between two poles: Deliberated Preferences, which integrate deliberation with standard stated preferences techniques and only encompass a limited departure from neoclassical welfare

economic theory, and Deliberative Democratic Monetary Valuation (DDMV), developed out of the 'deliberative turn' in democratic theory and adopting alternative theories of value, organising principles, and valuation vehicles (Kenter, 2017). In terms of empirical studies, Deliberated Preferences studies are dominant, with relatively few DDMV studies (Orchard-Webb et al., 2016). We seek to contribute to the literature on DDMV by exploring participants' perceptions of valuations arrived at through DDMV as opposed to more traditional individual willingness-to-pay elicitations. Perceptions of increased legitimacy for DDMV results would suggest that these provide a potential avenue for increasing the impact of environmental valuations in decision making.

We present an empirical case study of the application of our DDMV approach in the context of integration of natural and cultural heritage values in marine planning in Scotland, where a representative mini-public directly deliberated how much society should pay towards implementation of a draft integrated marine plan. We present the results of this case study and discuss the implications for the use of DDMV to inform environmental decision making. To our knowledge, this is one of only two studies to integrate DDMV into an active public policy process (Orchard-Webb et al., 2016).

6.1.1 From stated preferences to Deliberative Democratic Monetary Valuation

For the valuation of non-market goods and services, where no suitable proxy exists, a range of stated preference approaches are most commonly used. These approaches predate the ES concept but have been widely deployed in ES valuation studies (Curtis, 2004; Millennium Ecosystem Assessment, 2005; TEEB, 2010; Zarate-Barrera and Maldonado, 2015).

These methods rest on the neoclassical understanding of value as the marginal utility gained by a consumer from each unit of a good or service. The level of utility afforded is determined by individual, subjective consumer preferences which are held to be complete (include all possible goods and services), preformed and stable. The overall value of a good or service is understood as the aggregate utility gains it affords to all those consuming it. The purpose of valuation approaches is then to inform evaluation methodologies (most notably Cost Benefit Analysis (CBA)) that assess net overall utility of public policy alternatives, expressed through aggregate willingness-to-pay.

A number of ethical and conceptual issues have been raised with the use of stated preferences methods to underpin public policy (Kenter et al., 2015; Spash, 2007; Vatn, 2009; Zografos and Howarth, 2010). Key issues raised include poorly formed preference, challenges related to value plurality and commensurability, and the level of uncertainty associated with many public policy decision-making settings.

6.1.2 Poorly formed preferences

A significant and growing literature exists demonstrating that, as environmental goods and services are complex and often unfamiliar, many people do not have stable, preformed preferences regarding them (Bartkowski and Lienhoop, 2018; Brouwer et al., 1999a; Czajkowski and Hanley, 2015; Kenter et al., 2011, 2014a, 2016c; Lienhoop and Macmillan, 2007a; Macmillan et al., 2006; Szabó, 2011; Völker and Lienhoop, 2016). The neoclassical school frames this critique as one of 'information overload' or limited cognitive capacity, suggesting that respondents make 'irrational' valuations when confronted with such goods (Lo and Spash, 2013; Schläpfer, 2016). There appears to be growing consensus within the environmental valuation field that when dealing with complex environmental goods, stated preferences valuation studies benefit from a deliberative or learning element (Lienhoop et al., 2015), with a wide range of studies integrating such a component (e.g. Bartkowski and Lienhoop, 2017; Brown et al., 1995; Dietz et al., 2009; Kenter, 2016b; Macmillan et al., 2006; Wilson and Howarth, 2002)

6.1.3 Value pluralism

Beyond the issue of poorly formed preferences, critics of stated preferences also dispute the underlying marginal utility theory of value as appropriate for reflecting the range of values that can be expressed for the environment. Kenter et al. (2019) describe value pluralism at multiple levels: values can be considered plural in terms of: 1) content, for example, the difference between use and non-use values; 2) value lenses, for example, considering the difference between transcendental values (values as guiding principles and life goals) and contextual values (values as importance of something specific), or differences between instrumental, relational and intrinsic values; and 3) meta-lenses, which describe different epistemic and procedural assumptions about the conception and elicitation of values. Stated preferences approaches are only pluralistic in the first sense; in the second and third sense they implicitly assume that all values can be commensurate in a single value

indicator, namely individual willingness-to-pay based on instrumental, substitutable, self-regarding preferences.

While people clearly do have instrumental, substitutable preferences, this denudes the importance of intrinsic values that exist independently of the valuer (McCauley, 2006; O'Conner and Kenter, 2019; Potschin et al., 2016; Silvertown, 2015; Wilson and Law, 2016), and relational values that express the importance of non-instrumental relationships (Chan et al., 2018; Himes and Muraca, 2018). Furthermore, the utilitarianism associated with cost-benefit analysis disregards non-utilitarian meta-ethical interpretations, including deontology, virtue- and care-based and other ethical approaches (Chan et al., 2016; Farley, 2012; Jax et al., 2013). In extremis, neoclassical economists may (wrongly) interpret any ethical standpoint as a preference (Keat, 1997); alternatively, those who do not conform to utility-maximisation are excluded as protestors.

The individualism of stated preferences approaches similarly disqualifies rationalities oriented towards the value for one's community or wider social group. This has been defined as the issue of the consumer vs the citizen position (Ami et al., 2014; Howarth and Wilson, 2006; Soma and Vatn, 2014) or as 'I' vs 'We' rationality (Vatn, 2009); with standard stated preferences studies privileging the former. Empirical studies demonstrate that participants don't maintain just the 'consumer' or self-interested stance required by marginal utility theory during valuation exercises (Kahneman et al., 1999; Spash et al., 2009). Kenter et al. (2015) and Irvine et al. (2016) move a step beyond other-regarding values to develop the idea of shared value formation approaches that seek to elicit social values expressed not by individuals but collectively.

6.1.4 Dealing with uncertainty

In addition to the theoretical difficulties, valuation as part of the policy process is complicated by inherent uncertainties over the impact of policy decisions on socio-ecological systems (Sagoff, 2011; Schultz et al., 2015). Although valuations can take place with hypothetical future states, in reality public policy makers are faced with a range of potential and uncertain outcomes. Focusing valuation exercises purely on end states also fails to account for elements of procedural justice within environmental decision making (Ravetz, 2006; Schröter et al., 2017).

Attempts to disentangle values from empirics in normatively loaded settings of environmental decision making create a false dichotomy. Situations of high uncertainty that are normatively loaded have also been referred to as ‘post-normal’ situations. Previous work from Ainscough et al. (2018) has identified the benefits of adopting a post-normal perspective when undertaking ES research. Such situations call for a pluralistic understanding of forms of knowledge and embrace of complexity and uncertainty and the engagement of an ‘extended peer community’ of different experts and knowledge holders.

These various challenges against conventional stated preferences approaches mean that although they are widely used in environmental valuation studies, they remain contentious in policy making and their impact is questionable (Bartkowski and Lienhoop, 2018; Schläpfer, 2016).

6.1.5 Deliberative Monetary Valuation: Deliberated Preferences and Deliberative Democratic Monetary Valuation

Integrating deliberation into valuation is seen as potential solution to the issues outlined above, but the degree to which they are addressed differs between Deliberated Preferences and DDMV.

Deliberated Preferences sees deliberation as a solution to the issue of poorly formed preferences. These methods combine a traditional willingness-to-pay approach with a deliberative element focused on helping participants understand the goods and services being valued. There is evidence that respondents find Deliberated Preferences valuations less demanding and confusing than conventional stated preferences approaches, leading to higher confidence in willingness-to-pay bids (Jobstvogt et al., 2014; Lienhoop and Macmillan, 2007b; Macmillan et al., 2006).

In Deliberated Preferences studies, deliberation aims to induce valuers to behave as-if the preference assumptions of neoclassical economics held true. Such inducement has been termed ‘choice economisation’ by Lo and Spash (2013). Although these studies sometimes include discussions of alternative types of value, they primarily focus on overcoming the preference formation issue with conventional stated preferences valuation (Lo and Spash, 2013). The majority of studies described as DMV studies fall into this Deliberated Preferences category (Bunse et al., 2015).

Critics of the Deliberated Preferences approach suggest it does not move substantively from stated preferences, in that it retrains a focus on arriving at individual willingness-to-pay understood in broadly neoclassical terms (Christie et al., 2006; Kenter, 2016b; Lo and Spash, 2013; Macmillan et al., 2006; Orchard-Webb et al., 2016; Völker and Lienhoop, 2016). Deliberation emphasises professionals leading valuers through a process to provide clarification on facts and evidence (Lo and Spash, 2013). Alternative value types can be discussed, but they are not explicitly brought out or considered as part of the theoretical framework of preference construction or value interpretation. Kenter (2017) terms this 'weak value plurality', as opposed to 'strong value plurality' where different value types are explicitly brought to the fore through process design and output interpretation.

The second approach to DMV, DDMV, has evolved out of work on deliberative democracy, in particular drawing on the Habermasian concept of communicative rationality (Habermas, 1986; Hansjürgens et al., 2017). Here the emphasis is on providing space and opportunities for participants to develop their understanding of the value of the goods and services under question through a process of reasoned argumentation with fellow participants.

The core distinction of this approach is that no position of argumentation or line of reasoning is ruled out a priori, what Lo and Spash (2013) call 'choice democratisation'. The ultimate arbiter is that positions are defended in terms that are reasonable and acceptable to the group, and where the criterion of communicative rationality dictates that deliberations should be devoid of coercive power relations. As this ideal may not be perfectly attainable in practice, this means making active efforts to level out power and influence by structuring and facilitating the deliberations to maximise inclusivity and the effective capacity (socially and cognitively) of all participants to deliberate (Kenter et al., 2016c; Orchard-Webb et al., 2016). As in Deliberated Preferences, information and expertise will be presented and discussed, though here alternative value positions will be explicitly drawn out through process design (Kenter, 2017; Kenter et al., 2016c). This can include for example the discussion of broad transcendental values (Kenter et al., 2016c), or the explicit evocation to reason from the 'We' or the citizen position (Lienhoop et al., 2015; Vatn, 2009).

Although Habermas's concept of communicative rationality helps us to conceptualise legitimatisation through deliberation, this risks privileging the

transcendent ‘We’ position over alternative value positions (Bartkowski and Lienhoop, 2018; Lo and Spash, 2013). What makes DDMV distinct is that no value positions are privileged; the ‘We’ is not prioritised at the expense of the ‘I’. Communicative rationality does not oppose instrumental reasoning *per se*, as it can be included within it (Habermas, 1986). As noted by Lo and Spash (2013, p 784), “DMV should not be predefined as tied to any one value orientation or philosophy, otherwise it will soon fail to address incommensurability and value pluralism”. The same authors also warn against dysfunctional consensus, and highlight the possibility for deliberation to achieve more understanding and acceptance of each other’s values even when consensus is not achieved: “Deliberative institutions cannot make incompatible value positions compatible, but they can help them live peacefully and respectfully together” (Lo and Spash, 2011, p. 44).

6.2 DELIBERATIVE DEMOCRATIC MONETARY VALUATIONS IN THE POLICY PROCESS

DDMV recognises both the inherent uncertainties of environmental decision making, but also the inherently political nature of the valuation process (Ainscough et al., 2019, 2018; Lo and Spash, 2013; Orchard-Webb et al., 2016). Rather than drawing an artificial divide between the valuation and the context, DDMV allows valuation to be situated in the context as a point of contestation open to differing rationales and forms of reason. This is a potentially more appropriate approach to valuation in environmental decisions that are normatively loaded and where outcomes are highly uncertain – situations often described as ‘post-normal’ or calling for ‘post-normal science’ (Ainscough et al., 2018; Funtowicz and Strand, 2007). Some practitioners of DDMV, such as Kenter (2016a), describe their work explicitly as post-normal science.

It is for this reason that Kenter (2016b) advocates a move to a ‘public policy framing’ in DDMV studies, as an alternative to the ‘purchasing’ model implicit in many stated preferences or the ‘contribution model’ often adopted by participants (Kahneman and Ritov, 1994). The public policy framing aims to arrive at a judgement over whether the policy action is necessary, is likely to be effective and of the differential impacts it will have on groups within society (Dietz et al., 2009). Instead of individual willingness-to-pay, more appropriate payment terms include directly deliberated social willingness-to-pay - i.e. how much society should spend on a provision of an

environmental good, as opposed to spending this on another social good - or, at the individual level, ‘fair prices’ – an appropriate price to expect those in society to pay based on not just the anticipated benefits and the relative cost of securing alternative goods and services but any diverse communicatively rational considerations (Kenter, 2016b; Kenter et al., 2011; Sagoff, 1998; Szabó, 2011). Deliberated fair prices can be conceived to relate to deliberated social willingness-to-pay in that they represent individual (or household) contributions to the total; as such they may vary according to income or circumstances. For example, in our case study below fair prices are implemented through an income-dependent council tax, where those on the lowest incomes would be expected to pay only a minimal amount.

Moving to fair prices in DDMV allows a move away from the monetary value as consumer surplus or exchange price, and the ethical concerns (and potential protesting) that such a framing provokes (Gómez-Baggethun et al., 2010; Potschin et al., 2016; Schröter et al., 2014; Silvertown, 2015). A fair price arrived at through DDMV cannot be understood as comparable to market prices through the lens of neoclassical economics. It is instead a quantified expression of the monetary worth arrived at through group deliberation and can contain an array of different and potentially even contradictory logics. The valuation derives its legitimacy as an expression of an agreed position, or a workable compromise between those who would have to live with the consequences. Because they are based on a wide range of transcendental values and motivations, rather than utility-maximisation, it is questionable whether aggregated fair prices, or deliberated social willingness-to-pay, could be an input to conventional cost-benefit analysis. However, difficulties with mainstream stated preferences (hypothetical bias, difficulties comparing consumer surplus with market prices, etc.) also mean that they are not often used in cost-benefit analysis (Bartkowski and Lienhoop, 2018; Schläpfer, 2016). Furthermore, there is no reason why one might not compare deliberated social willingness-to-pay or aggregated fair prices with aggregate costs to consider whether deliberated social values of a policy option exceed the cost of providing it over a given time period, on the basis of unconventional assumptions, and this could usefully inform policy decisions. Estimates of costs could also inform deliberations on social willingness-to-pay or fair prices, with participants themselves judging on the basis of diverse criteria whether society should be willing to bear more or less than the cost.

6.3 CASE STUDY OF DELIBERATIVE DEMOCRATIC MONETARY VALUATION APPROACH ADAPTED TO FIT INTO A POLICY PROCESS

The validity of a DDMV derived fair price rests on it being seen as legitimate by those who are directly impacted by the change under discussion. Yet to date, few studies have assessed the perceived legitimacy of a DDMV-derived fair price as the basis for policy decisions as opposed to alternative stated preferences valuations (Ranger et al., 2016).

We developed a DDMV approach designed to test the acceptability of the derived value to participants in the process as compared to an individual willingness-to-pay (an approach more typical of a Deliberated Preferences study) (Kenter, 2016a; Orchard-Webb et al., 2016). At the end of a process of learning and deliberation, participants were asked for an individual willingness-to-pay. Following this they were asked to collectively deliberate over a group fair price. The first valuation is more typical of a Deliberated Preferences study – deliberation leading to expression of individual preference. The second valuation is more typical of a DDMV, where the valuation itself is deliberated over by the group. We then elicited feedback from participants with regard to the different approaches. In this way were able to test the confidence that participants had in these two different implementations of DMV.

We applied our method in a case study of marine planning in the Firth of Clyde, Scotland. We were interested in three core questions:

1- To what degree did participants value delivery of a regional marine plan relative to other public goods?
2- Which valuation did participants have more confidence in as the basis for public policy making, an individual willingness-to-pay or group deliberated fair price?
3- What types of arguments and value positions were expressed through group deliberation and how might these explain the difference in confidence between the two value articulations?

To adapt DDMV to the policy process, we undertook a valuation of a draft marine plan in its entirety based on the impacts the plan was predicted to have on various social, economic, and environmental metrics. Although we did not use an explicit ES framing in the communication to participants, many of the metrics under study can be mapped onto ES categorisations and the planning team who developed the

metrics did so in part using an ES framing, whilst there was also attention to the potential intrinsic values of wildlife and biodiversity.

The plan under study was the pre-consultation draft of the Clyde Regional Marine Plan. This draft was prepared by the CMPP over an 18-month period as part of a regional marine planning pilot project in Scotland, UK. The Scottish Government published a National Marine Plan in 2015 covering all activities under Scottish jurisdiction within its territorial waters. This plan is intended to inform the creation of 11 regional marine plans around Scotland's coast, with the Clyde and Shetlands regions acting as pilots before the model is expanded to other areas. The exercise took place after the pre-consultation draft was published (Figure 24).

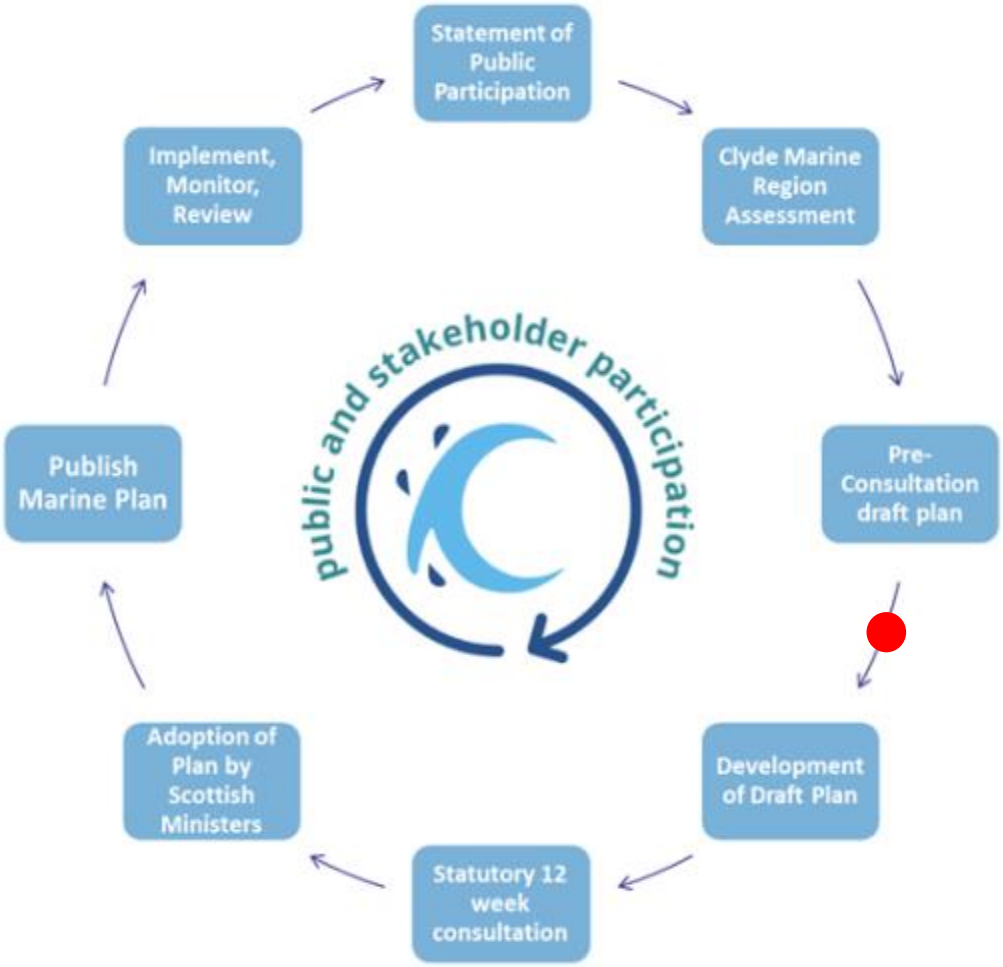

Figure 24. Diagram showing the regional marine planning process. Red dot marks stage at which DDMV conducted. Reproduced from: https://www.clydemarineplan.scot/about-us/about-the-clyde-marine-planning-partnership/ (accessed: 28/05/2020)

The study was designed to present a representative public panel with the Plan and its likely impacts on a range of environmental, social, and economic metrics, before leading participants through a series of deliberative exercises to arrive at a valuation for the implementation of the Plan. Participants were asked to value the additional benefits of the Plan as compared to a business-as-usual scenario where no plan is implemented.

6.3.1 Preparation work

The CMPP is the statutory planning body for the Clyde Marine Region and includes local authorities, business representatives, community groups and statutory and independent nature conservation bodies. The planning process began with a baseline assessment of environmental and socio-economic status of the Region (The Clyde Regional Assessment). This assessment drew on academic literature, grey literature, and expert assessment to appraise the status of multiple indicators in the Clyde. The CMPP also undertook numerous public engagement exercises, including commissioning a public dialogue to understand the views of communities surrounding the Clyde Region (Phillips et al., 2018).

From this data, the CMPP developed a pre-consultation draft plan including an overall vision for the Clyde, core aims and sets of general and sectoral objectives and policies. This plan was published for public comment, with feedback used to inform the creation of a draft plan for formal consultation. It was the pre-consultation draft that was taken as the basis for the valuation exercise. Our study took part separately from the formal marine planning process but was conducted in coordination with and with support from CMPP – for example, the specific locations of the work were chosen to cover places that were not previously covered by public dialogue about the plan.

To help workshop participants understand the impact of the plan on the Clyde region, an expert assessment was undertaken to predict the status of a number of indicators in scenarios in which the plan had or had not been implemented. These indicators were selected based on topic sheets prepared by the CMPP drawing from the Clyde Regional Assessment. All indicators are summarised in Appendix 1. The economic activities and cultural heritage features were expressed as graphs and maps and are not included in the table below. One topic sheet ‘Clean and safe’ was removed, as all indicators are in a relatively good status and the Strategic Environmental Assessment (SEA) showed minimal impact of the plan.

The SEA and Sustainability Appraisal (SA) were then used to identify policies that are likely to impact on the above indicators, using the following process:

- Each topic sheet was matched with the SEA and/or SA assessment category that best covered the indicator(s). For example, the indicators under 'mobile species' were matched with the 'biodiversity, flora and fauna' category in the SEA
- Policies were selected that were indicated as having a significant impact on this SEA/SA category (at least + 1 or – 1)
- The selected policies were reviewed manually for relevance to each specific indicator
- The remaining policies were refined to remove unnecessary details. For example, if a bullet point list was included in the policy, but only one bullet point was relevant to the indicator

Experts were then identified with expertise relevant to the different indicators and pre-existing knowledge of the Clyde Marine Region. Experts were presented with the relevant indicators and matched policies and asked to give an estimate of the likely status and trend of the indicators in two different scenarios over two timeframes:

- 10 years in the future if the plan is not enforced
- 30 years in the future if the plan is not enforced
- 10 years in the future if the plan is fully enforced
- 30 years in the future if the plan is fully enforced

Expert responses were then combined to give overall estimates for each of the relevant indicators. These formed the basis for the two scenarios used in the valuation workshops. A summary of the outcome of this exercise, as presented to workshop participants, can be found in the Appendix 5a.

6.3.2 Workshop location and audience selection

DDMV involves small group discussion. The lack of statistical analysis means that there is no need to achieve a particular sample size as is the case for approaches to monetary valuation such as choice experiments (Kenter, 2017; Lo and Spash, 2013). Instead participants should be selected to represent the social demographics and range of viewpoints towards the issue under investigation (Goodin and Dryzek, 2006).

Two valuation workshops were conducted in the Clyde region, one in a rural and one in an urban area. Participants were recruited by an independent recruiting agency to reflect the age, gender, and education-attainment make-up of the local area. Each workshop was half a day long, had 14 or 15 participants and was facilitated by members of the research team. Participants were given a monetary incentive to take part in the workshops to avoid self-selection bias. The workshops consisted of a mix of whole group presentations and breakout exercises in two smaller groups. At the end of each breakout exercise facilitators fed back key discussion points to all participants.

6.3.3 Workshop design

The workshop design was based on recommended steps for deliberative valuation from the Deliberative Value Formation Model (Kenter et al., 2016c). This is a detailed model that provides a theoretical and methodological foundation for deliberative valuation based on an understanding of key potential outcomes and factors that influence the process towards those outcomes, based on social-psychological and deliberative theory and practice. Following an introductory presentation on the regional marine planning process and the purpose of the workshop, participants were taken through the following phases:

6.3.3.1 Prioritisation

Following a warmup exercise requiring participants to recall a favourite memory or place in the Clyde, they were asked to vote for their top five transcendental values from a pre-prepared list (see Appendix 5b). These were compiled and the facilitator led a discussion on the top values as identified by the group.

Participants then separated into groups to undertake a cultural heritage mapping exercise. They were presented with a map of the Clyde region and asked to mark places of particular cultural significance to themselves and their communities.

Following the mapping exercise, participants were familiarised with the planning process through a presentation and the use of an informative video created by the CMPP. This presentation introduced the Clyde Regional Assessment and the topic sheets including indicators of environmental, economic, and social aspects of the Region. The next task was a prioritisation exercise, where groups were asked to deliberate over and then select the three (or more) topic sheets they considered to be most important.

6.3.3.2 Learning

In this step, participants were presented with the scenarios derived from the expert elicitation exercise described above. Given the inherent uncertainties in this exercise, the process for deriving the scenarios was described in detail to ensure participants did not misinterpret them as the result of extensive modelling.

6.3.3.3 Reflection

From here, individuals were asked to deliberate over the likely impact of the plan on the three criteria from earlier in the sessions. They were asked to consider the questions:

- Does the plan reflect the values expressed at the start of the session?
- How might the plan impact on the places identified as culturally significant in the mapping exercise?
- How will the plan impact on the aspects of the marine environment deemed to be the most important?

6.3.3.4 Valuation

After this process, participants undertook an individual willingness-to-pay exercise. They were asked to individually declare the percentage of council tax they would be willing to pay for the implementation of the plan, without discussion with other participants. They were also asked to express how confident they felt in their valuation on a 5 point-Likert scale and if they would prefer the sum was paid in addition to existing council tax or redirected from other services. An information sheet was provided with a breakdown of the percentage of council tax spent on various services delivered by local authorities (see Appendix 5c).

Following this, the groups joined back together to deliberate over a fair price, as a percentage of council tax, that they deemed the community should pay for the implementation of the plan. Here they were asked to put themselves in the position of policy makers and think about the valuation from the group, rather than individual perspective. Finally, participants were asked individually complete a feedback sheet in which they expressed their confidence in the group valuation on the same 5 point-Likert scale and to state which of the two valuations they would prefer was used by policy makers.

Figure 25 gives a summary of the workshop design and how these steps relate to stages recommended by Kenter et al. 2016 (Table 12).

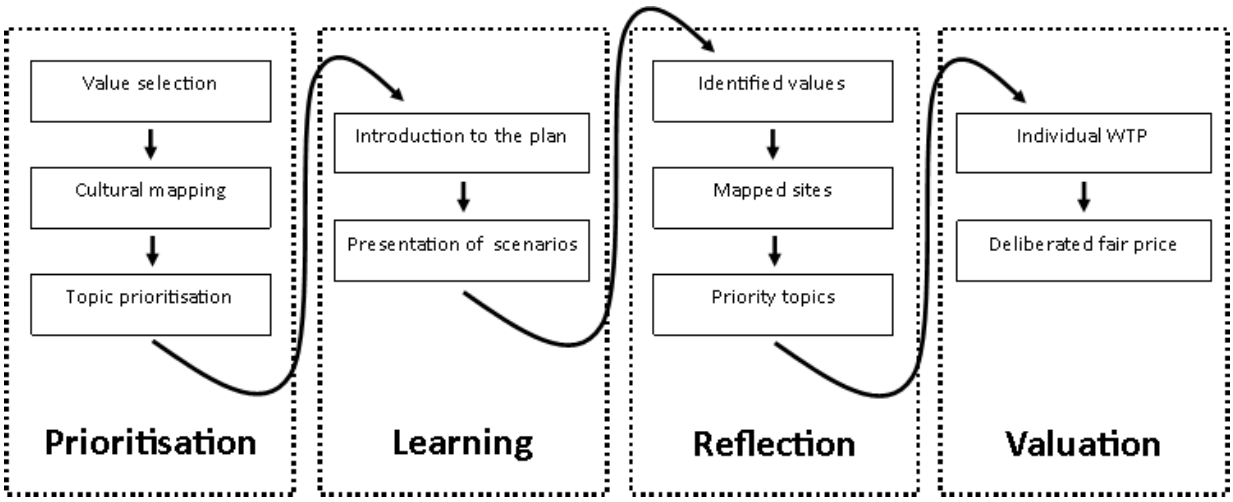

Figure 25. Flow chart summarising the design of the valuation workshop

Table 12. Mapping the steps of the workshop against the recommended stages of deliberative valuation from Kenter et al. (2016)

Stages of deliberative valuation (adapted from Kenter et al. 2016)		Workshop stage
Institutional context	Explaining the purpose of the valuation exercise and how it fits into the policy process	Workshop introduction
Transcendental values	Eliciting and deliberation over transcendental values of the participants and the communities they represent	Prioritisation
Contextual beliefs	Shifting focus to the issues at hand and building understanding the situations and the impacts of potential options	Learning
Implications for transcendental values	Discussing how possible options will impact on transcendental values deemed important	Reflection
Norms and contextual values	Integrating material from pervious steps and draw conclusions on norms and contextual values	
Value indicators	Expressing values through a particular indicator	Valuation

6.4 RESULTS

Below we detail the main discussion points and arguments that arose at each stage of the workshop. The differences in discussion in both settings is highlighted to demonstrate the differing issues and arguments that participants brought to the fore through the course of the workshop and in the final valuation.

6.4.1 Prioritisation - value selection

In both the rural and urban setting, a high number of participants (12 and 10) selected protecting the environment as a core value (See Figure 26). However, the two second highest in the rural setting, social justice, and family security, did not feature as prominently in the urban setting. The second highest scoring value in the urban setting, health, did not feature prominently in the rural setting.

In both locations, participants emphasised the difficulty of selecting just five top values, and they expressed surprise that neither wealth nor power received any votes. In the urban setting it was suggested that the values voted for reflected an 'ideal' rather than most peoples lived experiences. The emphasis on family security was reiterated during discussions in the rural setting, with participants emphasising the difficulty of finding secure work to provide for families in the area. This focus on the need for stable employment was further emphasised by the addition of 'employment' as a separate value by one participant.

6.4.2 Prioritisation - cultural mapping

The cultural mapping exercise resulted in discussion of currently important sites, such as those used for work and recreation, as well as the cultural history of the area. The key aspects of cultural heritage considered important by participants varied between the groups, with the rural setting emphasising the historical fishing industry and the urban area emphasising the significance of the ship building industry.

In the rural setting, participants recounted personal stories of sites that were a regular feature in their daily lives, rather than places they had heard of or visited for recreation as was more common in the urban setting. One participant, a local fisherman, recounted:

> In the summertime, the fishermen traditionally used to move their boats around to the west side of Kintyre, and obviously you have rougher seas around there compared to the Clyde. So, you would come back home for winter and you would go

around the Mull of Kintyre and you would think you are heading home. It was a bit of comfort and folk would say ‘you’re on the right side of Scotland now’… fairly calm water.

There was also a much closer sense of connection to the water itself, with one participant recounting: “The river itself was very important when I was at Uni (in Glasgow), it was the closest I could get to water. There wasn’t a day I wouldn’t at least run along the river. it was as close to home, as close to a boat as I could get.”

All mapped areas were logged and can be found on the PERICLES participatory mapping portal at www.mapyourheritage.eu.

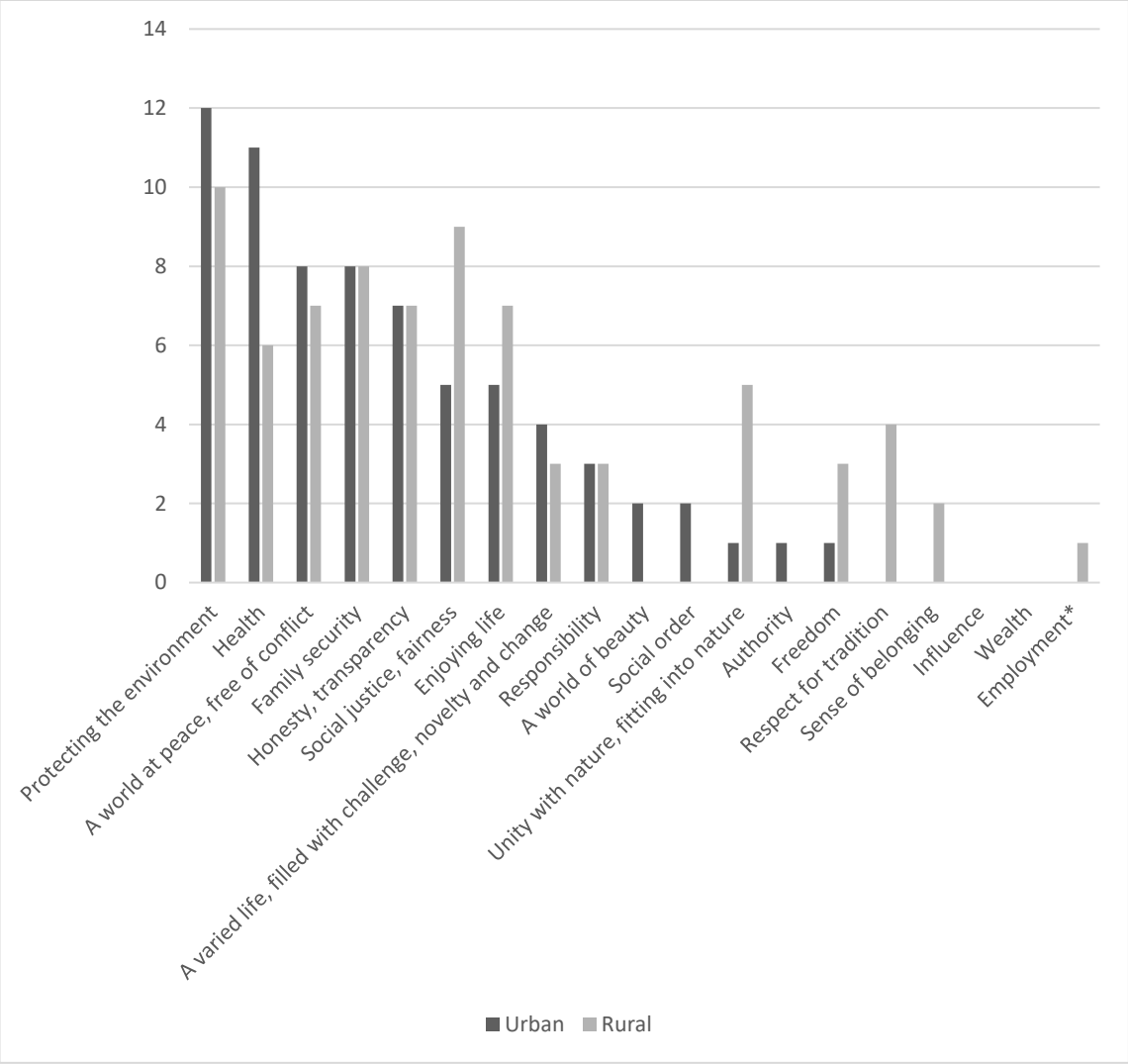

*Figure 26. Summary of values as voted for by participants of both workshops. *added to list by participant in rural workshop*

6.4.3 Prioritisation - topic prioritisation

There was significant convergence in priority features between groups, with fish and shellfish, marine litter and climate change appearing near the top in all prioritisations, and soft seabed habitats featuring prominently. Participants in both locations had similar conversations about these priorities, with two key points coming forward in both locations. The first was that all of the features are interconnected and therefore identifying the most important ones is difficult. One participant in the urban location remarked: “everything is so interlinked; it is hard to differentiate”. This led many to suggest selecting features that underpinned others. For example, many groups chose soft seabed habitats, as they were seen as important to fish species which in turn are important to the fishing industry and jobs. The second area of agreement was the overarching importance of climate change. As one participant in the rural location put it: “If it gets bad, it doesn’t matter what else you do.”

Yet whilst climate change was selected as important for all groups, all agreed that it was difficult to contribute to the mitigation of climate change within the locality covered by the Clyde Marine Plan. Adaptation through responses to sea level rise was seen as the most significant potential contribution of marine planning to climate change. In the rural site a participant also mentioned the issue of shifting fish stocks due to climate change, and the need to consider this dynamic in future planning decisions.

There were also differences between the sites during discussions over key features. In the rural area, there was significantly more discussion about the productive sectors and the need to provide jobs. One participant remarked as a reason for prioritising fish and shellfish populations as the basis of industry: “being a young person trying to stay in the area working in the marine industry, that sort of thing is so important because it is so difficult to stay here when you are so young, to try and get a mortgage, when everything else is seasonal.”

The seasonal nature of jobs in tourism was frequently referred to as a reason that jobs in industries such as fishing, and aquaculture are so important. As another participant put it: “This is why I went to Uni for four years and I now work in an office - I realised I could get a really good job for six months of the year and would have to leave the country for the other six months – which isn’t easy to do with 2500 sheep, 25 cows, a partner and a child.”

Another key difference between the groups was a significantly higher level of scepticism towards the data underlying the assessments in the rural location. Whereas many participants in the urban location were unfamiliar with the ecology and productive sectors of the Clyde region, those in the rural area were highly familiar and disagreed with some of the data used by the CMPP. The CMPP data was at this point significantly out of date, as it was several years old when the Clyde Regional Assessment was published. This fact is acknowledged by the CMPP, who see a focus on the continued collection of new and better data as central to the planning process. The need to rely solely on the Clyde Regional Assessment therefore contributed to the general scepticism around the data in the rural setting.

6.4.4 Reflection

During the reflection stage, participants in the urban group believed the plan reflected well on the values first identified, and saw it as finding a good balance between protecting the environment and the economy. It was recognised that many of the positive features of the plan were also determinants of health, a key value identified earlier in the session. Many participants also expressed a belief that a healthy environment underpins a healthy economy. As one participant stated: “If you don’t protect the environment, there is no point in anything else, you won’t have fisheries, or aquaculture or anything.”

There were some concerns that the plan was not impactful enough, as the scenarios showed that even over the longer time frame, fish stocks may not have significantly recovered. There was also concern that the plan in its current form may not sufficiently protect against and mitigate the impacts of climate change. One participant suggested the plan was a “step in the right direction”. There was also a feeling that the plan could not remain a static document and that:

> It will take time to see the reality of the plan, it can all sound fantastic on paper, but once it kicks into place, you might realise that things have to be tweaked, but you also have to see the reality of how it is playing out. Issues that you never thought about could arise – in positive or negative ways – it has to be fluid, changing to what happens in the environment in society and politically as well.

Suggestions that tourism could increase also raised some concern due to the potential for increased littering. In terms of cultural heritage, there was also a view that more could be done to protect smaller, less well-known sites. Another potential

gap identified was a lack of focus on education, which participants believed should be a core component to addressing many of the issues covered by the plan.

Although the participants in the urban setting expressed some concerns about the underlying data and levels of certainty, this was not as significant an issue as in the rural setting. Discussions in the reflection section of the rural workshop were quite different. Participants spent significantly less time discussing the scenarios presented and spoke more generally about the planning process. This appeared to be driven by two things, firstly a distrust in the data as discussed previously, and secondly a memory and general distrust of similar processes that had come before. Many participants expressed a worry that the plan would not suitably reflect the realities of living in rural community and the need to prioritise jobs offering year-round employment. There was concern that the priority value of family security could be undermined by excessive focus on environmental concerns.

The potential for increased tourism was viewed with some scepticism. While several participants worked in the tourism sector and did not see it as negative, there were concerns about high volumes of tourism as expressed below:

> I work in tourism, I do tour boats out to the Corryvreckan, without tourism it [the tour boat] wouldn't exist, but it is getting to the point that the massive demand for it, whereas we are losing… [pause] … the whole point of the West Coast [of Scotland] is that it has that slight exclusivity about it. It is a gift to be here, it is an absolute gift to be here, and you have these numbers coming through that just don't understand it.

Participants also reiterated the point that jobs created by increased tourism could not replace jobs in traditional sectors due to their seasonal nature. Outside of the specific scenarios and potential benefits, there was also a general feeling that a plan could bring an extra layer of bureaucracy or could repeat perceived transparency failings of previous initiatives such as the implementation of MPAs in the Clyde. There was a perception amongst some participants that the MPA designation process had been mishandled and led to significant jobs loses.

It was agreed that there was a need to balance the environment and the economy, but a perception that this had not been done well in the past and that the marine plan may repeat these mistakes. This appeared to be based less on the information presented in the session than a general mistrust of such initiatives. This was not

exclusively the case, with some participants speaking out strongly from the view that the plan would have significant environmental benefits in the long run.

6.4.5 Valuation

The mean individual willingness-to-pay was similar at both sites (Urban: 3.2%, Rural: 3.1%), however at the rural site this was skewed by two exceptionally high valuations (10.0% and 25.0%). The median was therefore chosen as a more suitable metric. This shows a lower valuation in the rural location (Urban: 2.3%, Rural: 1.0%). In both setting, the group deliberated fair price resulted in a range of values, with the rural group opting for an elevating contribution that would start at a low value (0.2%) and elevate to higher value (1.5%) over time if benefits materialised. This achieved agreement from the majority of the group, except for three participants who did not agree with the final valuation. These participants had also registered 0% for their individual willingness-to-pay. In the urban group, the two sub-groups settled on different valuations (2.0% and 4.0%) and there was insufficient time to reach a consensus in whole group discussion. It was agreed that the value should sit between this range but a final whole group figure was not arrived at. A summary of final values reported in Table 13 and Table 14.

During deliberation over the group fair price similar themes emerged in both locations, although uncertainty about the likelihood of benefits arising was higher in the rural setting, potentially accounting for the lower valuation. In both locations there was significant discussion over the issue of directing council spending away from other vital services, with participants in both locations having reservations about putting pressure on council budgets. Although facilitators tried to move the conversation beyond this to discuss the value of the plan relative to the importance of other services, discussions centred largely on the current underfunding of local councils. Also, in both locations, a number of participants inquired as to the cost of implementing the plan, seeking to set a price that matched the cost, rather than the value of derived benefits.

In both locations the number of people who felt confident in the group fair price valuation substantially increased as compared to the individual willingness-to-pay, and a large majority in both instances would favour the group fair price as the basis for decision making.

Table 13. Summary valuations statistics in the rural site

Rural					
Individual WTP		**Group fair price**		**Favoured**	
Median	1.0%	Value	0.2-1.5%	Individual WTP	4
SD	6.3%	Confident	9	Group FP	9
Max	25.0%	Unconfident	4	Don't know	2
Min	0				
Confident	5				
Unconfident	5				

Table 14. Summary valuations statistics in the urban site

Urban					
Individual WTP		**Group fair price**		**Favoured**	
Median	2.3%	Value	2.0-4.0%	Individual WTP	3
SD	2.9%	Confident	7	Group FP	10
Max	12.5%	Unconfident	3	Don't know	1
Min	0				
Confident	3				
Unconfident	5				

6.5 DISCUSSION

In this study we built on the Deliberative Value formation Model (Kenter et al. 2016) to develop a DDMV approach to derive a monetary valuation of the pre-consultation draft Clyde Regional Marine Plan. To our knowledge this is the first time a DDMV study has been conducted in the context of marine planning and one of the first to directly compare deliberated individual preferences and deliberative-democratically established monetary group values, which were established without relying on utility-based econometric models or analytic aggregation of individual preferences (Kenter et al., 2016a, 2011; Murphy et al., 2017; Sagoff, 2011).

A key outcome of successful deliberation is that it provides “participants with the conditions to learn about the ecosystem under investigation, to voice, debate and reflect upon their knowledge and views, and to learn about and take into consideration the values of other participants” (Orchard-Webb et al., 2016, 309). The prioritisation and mapping tasks in particular provided space for participants to learn from those around the table to ask questions of both the researchers and each other and develop a clearer view of the system and scenarios under study. The workshops received generally positive feedback from participants, many of whom remarked that they left the workshop with significantly more knowledge and insight – although this was less pronounced in the rural location where baseline knowledge was significantly higher.

Our study design allowed us to compare which of two separate valuations was favoured by participants as the basis for policy making, one more typical of a Deliberated Preferences design and the other more typical of DDMV. Our results show a majority of participants at both sites felt more confident with the deliberated fair price than their individual willingness-to-pay and favoured it as the basis for policy making. This supports the idea that DDMV using a fair price indicator is seen as more legitimate for informing public policy decisions than the more commonly used Deliberated Preferences approach, at least by those impacted by the decisions in question.

We also did not register any protest votes. Traditional stated preferences studies frequently evoke very substantial numbers of protestors, occasionally as high as 68% (Szabó, 2011) and their subsequent exclusion is an important point of contention for ecological economic theorists (Spash, 2007). Some participants chose to register a willingness-to-pay or zero and did not agree with the final group deliberated fair price. However, deliberation provides insights into participants motivations, which allows for a more nuanced handling of outliers. All those who expressed zero bids also gave an explicit and understandable reason. Either they did not think the plan was likely to produce benefits that would impact them, or they did not approve of the way the plan had been developed and had concerns over its impact on their lives. Such zeros were therefore not rejections of the valuation process and appeared to represent reasoned conclusions.

We discuss below potential reasons that deliberated fair price may have been preferred to the individual WTP. We then discuss some limitations to our study and

reflect on the potential use of DDMV in enhancing democratic participation in environmental decision making.

6.5.1 Why higher confidence in deliberative democratic monetary valuation?

The existing literature on DMV shows that value formation is a social process, and people reach decisions on their own values and preferences through discussion with others (Bartkowski and Lienhoop, 2018). It is now well established that time to deliberate with others allows people to more properly form their contextual values and preferences and reflect these back into the discussion (Bunse et al., 2015). However, it is likely that factors beyond individual preference formation account for the difference in confidence between the individual and group deliberated values.

The core purpose of DDMV is not individual preference formation, but to allow reasoned arguments to be brought out, that have a bearing on the valuation at hand, without artificially limiting the number of 'legitimate' positions. The process gains legitimacy as those engaged are in a position to accept or reject reasoned positions, and they are the ones that will have to live with the consequences of decisions taken (Lo and Spash, 2013). Participants are not expected to adhere to any pre-determined theory of value or reason (whether based on a single interpretation of value as satisfaction of individual, self-regarding utilitarian preferences, or any other monistic value criterion; Kenter, 2017), but instead are tasked with reaching, "mutual understanding and a common solution… through group inter-action and exchange of argument" (Bartkowski and Lienhoop, 2018, p 98) and whilst minimising influences of relative power over argumentation. As others have, we saw evidence of communicative rationality through the workshop, and particularly in the final group deliberation task. Here participants made reasoned cases for their own position that in some cases caused others to change their initial valuation and helped the group move toward consensus (Orchard-Webb et al., 2016). The resultant valuation may be seen as more acceptable, not just because it is underpinned by multiple normative and epistemic positions , but also because it reflects a 'workable agreement' between participants (Dryzek, 2000; Lo and Spash, 2013).

The range of value positions and priorities expressed was broad and pluralistic. This came partly from research design, with transcendental values explicitly elicited and integrated through the process. Transcendental values have been under-recognised in ES research which has mostly focused on contextual values and preferences (Raymond and Kenter, 2016b); this research confirms the DVF model assumption

that explicit prompting for expression of plural transcendental values and subsequent space for discussion on how these values can be applied within the given context is essential in forming contextual values (Kenter et al., 2016c).

There was also evidence of reasoning from both the 'I' and the 'We' position. In the rural setting in particular, the impact the plan was likely to have on the local community was a significant concern for many participants, alongside more self-oriented values, such as concern for personal income and employment.

There were also those in the valuation that expressed a desire to protect nature for nature's sake – expressing and becoming a voice for non-human nature and the defence of intrinsic values, pointing to deliberation as a venue for 'more-than-human' participation (Bastian, 2017; O'Conner and Kenter, 2019). The framing of the exercise made it possible to bring such concerns into dialogue with more instrumental concerns connected to the jobs and industry supported by the marine environment and relational value expressions justifying protecting nature on the grounds of people's experiential connections.

In their DDMV study on values for a large number of UK marine protected areas, Kenter et al. (2016a) found that instigating a public policy framing brought out a number of considerations also observed in our study. These include the consideration of who will benefit and over what time scale, the different needs of those beneficiaries, competing priorities for spending, duties to other species and future generations and responsibilities towards particular areas and sights. These concerns are thought to be common in group valuation tasks (Kahneman et al., 1999; Spash et al., 2009), but difficult to integrate in valuations through more conventional stated preference tools (Brouwer et al., 1999b).

Participants were also able to integrate a range of institutional considerations that would be out with the scope of stated or Deliberated Preferences approaches. For example, participants inquired as to how much it would reasonably cost to implement and enforce the plan. In the context of public policy, especially in a time of budgetary constraints, the question of the minimum cost at which such benefits can be delivered is a highly relevant factor in valuation. There was significant debate over the burdens that local authorities are under. Although the 'council tax' valuation metric being used was an artificial construct, because different elements of the plan would in fact be funded from different sources, in a rather complex and dispersed

way (as explained to participants) there was a clear agreement that competing expenditure priorities should be a consideration reflected in a ‘fair price’.

Another reason that participants may have preferred the fair price, is that they were able to agree a valuation that integrated group concerns over uncertainty of the benefits accruing. One group was able to reach agreement on an elevating fair price that accounted for uncertainty. The ability of DDMV participants to deal with the uncertainty and risk inherent in public policy decisions is an advantage over Deliberated Preferences approaches that rely on more rigid instruments to ensure individual preferences adhere to the same framing and can be econometrically modelled. As Orchard-Webb et al. (2016, p. 311) note, “DDMV provides more flexibility in dealing with complexity, uncertainty and risk, as deliberations on the social value of different policies can come to conclusions accounting for a lack of evidence, by deliberating whether society should pay for precautionary measures or should accept risks.”

Not delineating legitimate lines of argumentation thus meant a wide array of concerns and considerations were reflected in the final valuation. Such an approach is what is meant by ‘choice democratisation’ in DMV and is suggested by Lo and Spash (2013) as necessary to ensure deliberative valuations adhere to the deliberative democratic theory on which such valuations are built.

Finally, it is also possible that the ‘fair price’ framing itself was seen as more appropriate as the basis for public policy decisions than individual willingness-to-pay. Kenter et al. (2016a) suggest that during deliberation people will typically bring in issues of fairness and that the notion of ‘fair price’ intuitively appeals to participants as a more appropriate payment term for social goods than individual willingness-to-pay. Dietz et al. (2009) suggest that deliberation naturally pushes people towards more of a public-policy type of reasoning, and this intuitive appeal also resonates with ethical models that point out the non-sense of establishing value to society through aggregation of self-regarding individual consumer preferences (Sagoff, 2007).

6.5.2 Limitations of the study

Our study had a number of limitations that would need to be considered in further studies of this type. Firstly, the primary goal of this study was to develop DDMV conceptually and methodologically as a social valuation approach with influencing the marine planning process a secondary goal. The exercise was carried out by a

group of researchers separate from the team developing the plan and was therefore not formally part of the planning process. The authors have previously facilitated public dialogue on behalf of the CMPP (Phillips et al., 2018) and various elements of the research design in that work were replicated in this study, and some elements of the design (e.g. choice of locations) were chosen in discussion with CMPP. The results of this study were also fed back to the CMPP within a timescale meaningful to the Clyde Marine Plan decision making process. However, a DDMV, could be developed, and undertaken in even closer collaboration with decision makers to enable more direct integration into the decision making process (cf. Ranger et al., 2016).

The data on future scenarios used in our study were also highly uncertain. Experts involved in the preparation of the workshop material were only able to provide estimates of future states. This fact was stressed to the workshop participants and caused many to be sceptical that the presented benefits would materialise. In addition to this, a reliance on the data available through the Clyde Regional Assessment meant that baseline data was in some cases many years out of date.

In this valuation we asked participants to value the whole plan, rather than individual benefits and services derived from the plan. This was an attempt to overcome the abstract nature of some valuation studies and make the resulting figures more applicable to the policy process. This carried both advantages and disadvantages. A key advantage was that it allowed participants themselves to assess any positives of the plan, including other-regarding benefits and intrinsic values, as well as negatives, and judge overall what the importance of the plan was to society as it was drafted by decision-makers. It also did not imply trade-offs should or could be made between different elements of the plan, and by avoiding a consequentialist framing of trade-offs, participants were able to freely deliberate from any moral position, whether this was from a utilitarian, deontological, eudemonic or any other ethical perspective, and allowing people to form and express diverse narrative-based ethics (O'Neill et al. 2008). The flip side of this was that we were not able to identify the specific elements of the plan that participants valued most quantitatively, although these were highlighted qualitatively through the positions that they presented during deliberation.

The level of complexity of the bundle of goods and services that participants were asked to consider was also problematic. Although only a reduced number of

indicators were used, it was necessary to retain a significant amount of information to allow the valuation exercise to reflect the plan as a whole. This holistic approach to considering the impacts of the plan left participants with a significant amount of information to process. Although participants were sent information in advance, many did not have time to become familiar with the scenarios being presented.

In the end, it appeared some participants were valuing the idea of planning itself, or expressing a general desire to protect the environment, rather than weighing the multiple goods and benefits the plan may or may not deliver. This was exacerbated in the rural environment where a familiarity with the marine region led to high scepticism of the underlying data and the presented scenarios. This was reflected by such statements as ‘well we have to try and do something’, or alternatively as expressions of 0% value. Consequently, this issue, which is common to stated preference approaches, where what people are actually expressing is “an attitudinal expression of support for a good cause” (Kahneman and Ritov, 1994), was not fully addressed by the half-day valuation workshop based approach.

An improved approach would involve an transdisciplinary team of researchers and decision makers undertaking a more thorough participatory scenario development (Reed et al., 2013) and mediated modelling (van den Belt and Dietz, 2004) exercise to increase participants trust in the scenarios being presented to them. Participants could be given more time to familiarise themselves with the presented scenarios through the use of multi-day workshop design. However, these improvements have substantial resource implications and take substantially more time, which would both limit the potential for the implementation of such an approach into planning practices.

Implementing fair prices through a council tax payment vehicle had a number of advantages. Firstly, it is weighted for income in a way that is relatable to most adults. In the UK, people who own larger houses typically pay higher council taxes, and those on the lowest incomes are excluded from paying the tax entirely. Therefore, by asking people to express a group fair price through such a metric reduces the need to weight monetary amounts by income levels. The second advantage is that information on the percentage of council tax spent on other services is relatively easily accessible and understandable. Providing participants with this information allows them to consider the benefits of the plan as compared to relatable goods and services and directly compare in similar percentage units,

allowing the environmental debate to be situated within broader consideration of social priorities, which individual budget-based framings of conventional stated preferences are unable to achieve. Thirdly, the tax is local, matching the regional nature of the plan better than a national tax.

However, the council tax framing also substantially influenced the direction of debate. Discussions were dominated by considerations of the degree to which councils could be asked to divert funds from other services, or whether it should be raised, or indeed if council tax was the correct vehicle for payment as compared to national of industry funding. As seen by Szabó (2011), a number of participants also voiced general concern about “another tax” or “not being sure where the money would end up”. These are legitimate considerations in the DDMV and under the guidance of facilitators, participants agreed to disagree on to whether the funding should be achieved from tax rises or cuts elsewhere, and to focus on the relative importance of the plan. Nonetheless, these considerations are also specific to the metric used and an alternative payment vehicle may have resulted in different value outcomes.

An important limitation was that we were unable to disentangle the effect of participants having more time to consider their views and the effect of group deliberation (Kenter et al., 2016a; Ranger et al., 2016). As outlined above, it is possible that the fair price valuation taking place after the individual willingness-to-pay meant participants had had more time to consider their views, and that this ordering had a significant bearing on the result.

Also, as with any form of DMV, group dynamics influence the process of value formation (Kenter et al., 2016c). Although participants were generally respectful to each other, and the researchers taking part in this study were experienced facilitators that used active facilitation techniques such as warm up exercises, structured prompts, go-rounds, active intervention to stop individual participants from dominating discussions, and prompting less vocal participants to provide their views (Jordan, 2014), there were clear examples of group effects in both contexts. These were primarily driven by knowledge asymmetries between participants, with one or two members of a group having significant background knowledge of the subject matter, and other group members deferring to them for judgements. This was, however, more pronounced in the earlier stages of the process that were explicitly informational, and less pronounced during the valuation deliberations.

These types of group dynamics have been noted by others in deliberative valuation studies, are seen as an inherent challenge (Kenter et al., 2016b; Orchard-Webb et al., 2016; Vargas et al., 2017; Völker and Lienhoop, 2016). The degree to which they are problematic will depend on the degree to which individuals do not just provide knowledge but also are able to use this knowledge to direct value narratives based on the social status that their knowledge may provide. This can be moderated by facilitation but also by bringing a broader variety of knowledge to the table through diversity in group composition (Devente et al., 2016). Again, a longer drawn out process where participants could be exposed to more extensive learning and exposure to multiple experts and stakeholders could address these issues to some extent, but at a financial cost.

6.5.3 Developing deliberative institutions

DDMV is not appropriate for all valuation situations as the value derived is not grounded in neoclassical welfare economics (Lo and Spash, 2013). Whilst this is a strength in terms of its ability to act as a boundary object between different normative and epistemological positions, this decreases its comparability between contexts. Decision making apparatuses such as cost-benefit analysis are based on rigid theoretical underpinnings that would make it problematic to attempt to include the results of a DDMV. Yet cost-benefit analysis is a disputed policy tool and has a questionable impact on decisions taken in the real world (Turnpenny et al., 2014). Indeed the interest in DDMV and other deliberative forms of decision making speaks to a rejection of overly technocratic forms of decision making and perceived democratic deficit (Symes, 2006; Zografos and Howarth, 2010).

The nature of the validation of a DDMV also mean figures cannot be generalised to other geographical areas or populations. Rather than statistical significance, DDMV aims for representation of the views and backgrounds typical of the citizens or stakeholders being impacted by decisions (Kenter et al., 2016d). As was seen in our study, two areas within the planning areas of the Clyde Marine Plan came to significantly different valuations, reflecting their specific circumstances and views. It cannot be assumed that people from different geographic backgrounds will bring the same reasoning to the table or that these arguments can be predicted by social-economic and demographic indicators such as gender, age, education, and income. This is particularly the case in deliberating environmental values, which are characterised by idiosyncratic place-based differences, such as exemplified by the different heritage and associated cultural meanings of the sea between our two

locations. DDMV can be scaled up to larger areas by ensuring location forms part of the screening criteria for participants or by holding multiple sessions in different sub-regions, the latter approach will bring out place-based values more explicitly, yet is also likely to be associated with greater resource requirements

Despite these various challenges, we follow Orchard-Webb et al. (2016) in concluding that deliberative methods grounded in deliberative democratic theory have substantial potential to address concerns with environmental valuation regarding value plurality, uncertainty, procedural justice, recognition of voice, addressing key drawbacks of both stated and deliberated preferences approaches. Lienhoop et al. (2015) suggest that policy makers need more than a single number, they require contextual information as to the reasons and arguments that are compelling to people impacted by decisions. Similarly Church and Ravenscroft (2011) conclude that, to decision makers, the defensibility of evidence to those impacted by decisions it informs is as important as its 'quality' (defined in strictly scientific terms). Further, for our participants, the DDMV derived fair price had more legitimacy as the basis for public policymaking than individual willingness-to-pay, even when this willingness-to-pay had been assisted by a significant process of learning and deliberation. This perceived legitimacy in itself is likely to increase the confidence that policy makers have in acting upon the output of the valuation.

DMV in the broader sense has been criticised on normative grounds for insistence on a single figure (Lo and Spash, 2013). However, valuation as a single figure provides a useful boundary object around which to both explore various reasons and arguments and span differing perspectives. Framing the exercise as a valuation brings in many of the dimensions discussed above, with high pertinence to the policy process. Given the potential value of the much higher amount of contextual information from a deliberative than a non-deliberative monetary valuation, and the recognition that expressed values in DDMV do not reduce plural ethical motives to consequentialist trade-offs, DDMV can provide key benefits of monetary valuation to policy makers, without the ethical reductionism inherent in stated and deliberated preferences methods.

However, for DDMV to be truly effective, it must be more fully institutionalised in decision making practices. Despite an explosion of interest in social and cultural values, economic valuation in the policy process usually still adopts standard neoclassical approaches. The rich array of theoretical and methodological

contributions made by the ecological economics community toward environmental valuation appear at present to be underutilised. We believe there is substantial scope to formally integrate approaches such as DDMV into decision making institutions, as part of the current wider turn toward more decentralised and participatory environmental governance that is apparent in many places (Bremer, 2014; Bremer and Glavovic, 2013; Kelly et al., 2018).

6.6 CONCLUSION

Despite limitations, our study successfully resulted in an economic valuation for the public policy choice in question that was broadly supported by participants.

Our study demonstrated the value of DDMV for environmental valuation in the context of public policy formation. We are able to arrive at deliberated fair prices for the introduction of a new package of policies that had broad support from participants. Such an approach would allow for the comparison of new environmental policy with existing goods and services provided by the relevant public body.

By integrating learning, valuation exercises and deliberation, we were able to create a valuation process where a wide plurality of value types were expressed and discussed. Participants had higher confidence in the fair price valuation arrived at through deliberation than in their individually stated willingness-to-pay valuations. This provides support for the benefits of deliberation as an approach for dealing with valuation tasks characterised by high uncertainty and value incommensurability. These findings should cast doubt on the appropriateness of neo-classically derived stated preference approaches for the valuation of complex environmental goods and services.

AFTERWORD

Thesis questions this chapter addresses

Q3. How should assessment and valuation institutions be designed to avoid reductionist tendencies in the ES concept?

In this chapter I present a methodology for undertaking environmental valuation in a manner that accounts both for uncertainty, plural values and principles of deliberative democracy. The indicators under study in the workshops were not framed as ES, but drew on existing indicators derived by the CMPP. These included a number of indicators that could be defined as ES, as well as a number focused on environmental pressures. This methodology would be equally as applicable to a study explicitly adopting the terminology of ES.

This methodology demonstrates the capacity of group deliberation to derive a monetary valuation with legitimacy in the policy process. As identified in Chapter 4, despite a turn towards more participatory and devolved decisions making, the explicit consideration of social and cultural values is still often lacking from the policy process. This method could be adapted and integrated into participatory policy and decision-making processes.

7 CONCLUSION

It is a central contention of the thesis that the ES concept will never have just one definition. That it will be defined and redefined within different contexts. This allows it to operate as a boundary object, but also opens the door for potential misuses of the concept. Since its inception, there have been concerns that the ES concept is tantamount to 'putting a price on nature' and a slippery slope towards commodification. Through this thesis I have sought to both investigate and inform the process by which the ES concept is integrated into environmental governance. I have done this both to contribute to ongoing discussions about the implications for the concept, but also to demonstrate that the process of commodification is far from inevitable. The ES concept also holds the potentiality to bring a more nuanced and pluralistic view of the human nature relationship into how decisions are informed and made. This thesis is intended to foster this latter interpretation of the ES concept. In this final section I will summarise the argument of the thesis in light of my two main research objectives:

Objective 1. To explore the process by which the ES concept is embedded in governance practices, and how this process shapes and is shaped by competing potentialities within the ES concept

Objective 2 Identify principles and approaches to the operationalisation of the ES concept that avoid reductive tendencies within the concept and reflect the complexity of the human-nature relationship

7.1 SUMMARY OF ARGUMENT AND FINDINGS OF THE THESIS

I began the thesis by presenting an overview of the ES concept and key debates that surround it. There are an ever-growing number of conceptual frameworks and categorisation systems (Albon et al., 2014; Costanza et al., 2017; Haines-Young, 2011; Jones et al., 2016). And debates continue regarding assessment methodologies, modelling approaches, and value theory (Boerema et al., 2017; Jacobs et al., 2016; Schröter et al., 2014; Turner et al., 2015). Yet although no one can quite agree how to define it, there are widespread desires for the concept to be integrated into decision making (Billé et al., 2012; Daily et al., 2009; Hermelingmeier and Nicholas, 2017; Laurans et al., 2013; Nahlik et al., 2012; Schröter et al., 2014).

This lack of unified definition fuels a number of fierce debates over the implications of the concept. I summarise these debates as between those who see the ES concept as an overly reductionist conception of the human-nature relationship, and those who see within it the potential for a more pluralistic and nuanced view. The reductionist charge is that the ES concept reifies values down to market prices and renders complex socio-ecological systems as simplistic stocks and flows. At best, this reductionism is a gross oversimplification of the many ways in which humans live in, from and with the non-human world. At worst it is the door to a neoliberal dystopia of commodification and market forces. These charges are all met with defences from within the ES community. Scholars emphasis how a plurality of value types and ethical traditions can be integrated into the concept, and how different academic disciplines and knowledge types can be combined under the ES rubric to further our understanding of earths complex life support system.

In the reductionist vs pluralist debate, I don't argue that one side is wrong, and the other right. As a loosely defined boundary object, it is clear that both possibilities are contained within the ES concept. The important point is to derive principles and methods to guide the application of the concept that guard against its reductionist tendencies. This becomes increasingly important as attempts to integrate the concept into policy and decision-making institutions accelerate. This is the task that the thesis seeks to contribute to.

In Chapter 2 I introduce the critical realist position. A philosophical stance that has informed my approach to this thesis and that I think is highly applicable to a pluralist understanding of ES. In Chapter 3 I presented the results from a mixed-method survey into perceptions of the ES concept. From this survey, with co-authors, I identified a series of guiding principles for informing the future development of the ES concept. These were a commitment to inter- and transdisciplinary working, a more explicit consideration of social and cultural values, and the need to link ES explicitly to principles of sustainability. These principles had broad agreement from respondents and can contribute towards efforts to integrate the ES concept into decision making institutions. However, a division was identified between academics who wished the concept to be used in decision making, and policy makers who saw it at that point as an awareness raising tool. Perceived barriers to the inclusion of the ES concept in policy and decision making included a lack of conceptual clarity and lack of a tools or guidance for deployment. For the ES concept to be operationalised

in policy and decision making, it is necessary to develop specific terminology, tools and work practices, what I call ‘infrastructure’, following Steger et al (2018). This presents a problem, as disagreements and ambiguities in the concept relate to some fundamental epistemological and normative concerns (as discussed in Chapter 1). There is no reason to believe these can be reconciled into the shared understanding required for conceptual clarity.

To accede to demands for consensus, seen as a prerequisite for integrating the concept into decision making, would limit the ES concept’s capacity to act as a bridge between different groups. It would delineate the epistemological and normative frame within which the ES concept sits, limiting the scope for engagement from actors with different worldviews. This would isolate certain groups with potentially useful insights and knowledge limiting the potential for future collaborative work, that is, it would limit its capacity to function as a boundary object. Cementing a clear conceptualisation of the ES concept also risks privileging certain groups and worldviews, with the resultant institutional forms for assessing ES reflecting existing power dynamics.

To resolve this tension, I propose understanding the ES concept as existing on two levels, first as a loosely defined boundary object, and second as context specific set infrastructure. The form this infrastructure takes is likely to be shaped both by existing institutional structures and the prevailing norms and policy priorities within that context (Foxon, 2002; Kull et al., 2015; Pierson, 2000; Steger et al., 2018). It is ultimately in this process of infrastructure creation that either the reductionist or pluralist potentiality within the ES concept will be brough out and cemented in governance practices. This highlights the importance of studying how the ES concept shapes and is shaped by the context in which it is embedded.

I explore this theme further in Chapter 4 through a case study of ES institutionalisation in inshore marine governance in Scotland. I conceive of the institutions governing the inshore marine environment as a policy mix, where each policy tool is a potential institutional venue for the integration of the ES concept. This study showed that there is interest amongst policy makers in using the ES concept, though the process of institutionalisation is far from complete. Yet even at this incomplete stage, it is possible to identify how existing institutions and context norms are shaping how the concept is operationalised.

Between institutional contexts, there is minimal consistency in the framing and conceptual apparatus used to define the ES concept. It can be seen in use as a boundary object, bringing together different parties to attempt to work out its implications for inshore governance. Several instances of its use are more advanced, and it was possible to decern the process of infrastructure creation. The most advanced example is within regional marine planning, where detailed methodologies have been devised for assessing ES as part of the planning process (Shucksmith et al., 2014; Shucksmith and Kelly, 2014).

From these types of use, both a more loosely formed coming together of ideas, and also specific projects to build infrastructure, it is possible to see the influence of both existing institutional forms, norms and policy priorities. The institutions that are most embedded are the least likely to integrate considerations of ES, while newer institutions are more likely to. For example, attempts to adopt the concept in the context of River Basin Management Planning, where it would have an impact on aquaculture development, were unsuccessful. By contrast, efforts to implement the concept in marine planning, a much newer institutional form, were more successful. The first Scottish River Basin Management Plans were published in 2009, whereas the first Scottish National Marine Plan was not published until 2015.

Similarly, it is possible to detect the influence of key policy directions, such as a concern for climate change, in the way the concept is deployed. This is especially true when looking at the direction of government-funded research into different ES. The concept has also generally not been deployed in situations where an overriding economic imperative guides the development of regulation, such as in the aquaculture sector.

The increasing norm in Scotland towards devolved and participatory planning and governance approaches also appears to be influencing the way the concept is integrated. This type of participatory governance also follows trends in the development of Scottish inshore governance institutions toward the integration of local knowledge into decision making and planning. This approach to planning and decision making has a two-way symbiotic relation with the imperatives of the ES concept. Elements of the concept, as outlined in Chapter 2, imply an approach to knowledge creation that is epistemologically pluralistic and draws form a range of different knowledge types and legitimation processes. This can be seen as a barrier to its use in certain contexts, while enabling its use in others. These trends in

Scotland suggest that putting a ‘price on nature’ is not at the forefront of policy makers minds, and there is scepticism towards monetary valuations.

I also found a number of general barriers or challenges to the uptake of the ES that were relevant to varying degrees across all potential venues, these were: the lack of reliable data; difficulty of deriving accurate valuations; the lack of regulatory or legislative drivers; questionable legal defensibility of actions taken based on assessments of ES; the lack of any national performance indicator linked to ES; and competition between an ES framing and alternative approaches to policy formation.

There were three additional findings from the Scottish case study relevant to the overall argument of this thesis. First, is that the ES concept actually appears to lend itself to more participatory governance settings, potentially providing an opportunity for the more pluralistic potentiality within the concept to be expressed. With commodification not appearing to be a danger, at least in this context, the second observation is that the more genuine issue with ES institutionalisation is the obstacle posed by entrenched interests. Though there appears to be no overt hostility towards the concept in the Scottish context, it has as yet not been taken up in any setting where it might disrupt existing commercial interests. The final takeaway from this case study is the lack of consideration of pluralistic environmental values, identified in Chapter 3 as a key steering principle for ES.

In Chapter 5, marks the start of the prescriptive element of the thesis that explicitly seeks to promote a pluralistic interpretation of the ES concept. I develop an argument for a post-normal science approach to ES research. Post-normal science is applicable in situations where there are high levels of uncertainty, urgent decisions, and embedded normative considerations. It deals with these through the introduction of an extended peer community and epistemological pluralism. A review of ES literature demonstrated that there are elements of a post-normal science approach already adopted within ES research. In this chapter I made the case for an explicit adoption of this approach. This conception of ES research can help to guide the development of assessment infrastructure in situations of participatory and deliberative governance institutions. As shown in Chapter 4, it is these institutions that appear as the most likely venue for the deployment of the ES concept.

In Chapter 6, I brought together findings from previous chapters and circled back to a potential weak point in the development of emerging infrastructure in Scotland: the lack of explicit consideration of plural values in assessment processes. Reviewing

existing literature on deliberative valuation and drawing insights from earlier chapters, I developed a methodology to test a deliberative valuation approach in the context of marine planning in Scotland. I demonstrated that this method is capable of identifying monetary valuations for a plan that carry higher public acceptance than traditional stated preference approaches. This higher level of legitimacy strengthens the argument for adopting such an approach in the context of participatory and deliberative governance institutions.

7.2 ES AND THE PRINCIPLES OF SUSTAINABILITY

Embedding the principles of sustainability within ES research and practice was identified as guiding principles in Chapter 3. A number of proposals for conceptually linking the two are discussed in that chapter. Central amongst these was the need to move away from the mindset of maximisation, towards a mindset of limitation. Too much ES research focuses on improving efficiency and maximising value generation from a given ecosystem. Yet growing body of research shows that on aggregate, we cannot reverse environmental degradation simply by improving the efficiency of our use of environmental resources and sinks (Hickel and Kallis, 2019; Kallis, 2011; Wiedmann et al., 2015).

In the case study presented in Chapter 4, the ES concept was primarily seen as a tool for trade-off analysis between competing beneficiaries of environmental goods and services. In contexts where ES research pointed towards the limitation of economic activity, findings have been ignored or not acted upon. Environmental regulations that do seek to place limits in activities can be, and often are subject not just to political contestation but sometimes legal challenge. The identified barrier to the adoption of the ES concept of 'legal defensibility', was most apparent in Chapter 4 in contexts relevant to the direct regulation of commercial activities.

This trend is unlikely to be unique to the Scottish experience. The over-riding imperative of economic growth is ubiquitous and the answer to environmental degradation in capitalist societies is to either substitute an exhausted resource for another, or to seek to improve the efficiency of a process to limit the necessary inputs. Economic growth, from Malthus forward, has been presented in classical and neo-classical economics as a way to overcome limits (Kallis, 2019). Indeed 'non-satiation' is a bed rock assumption of rational preferences in neoclassical economics – more is always better. Economic growth is how many contemporary governments judge their actions and how many people gauge societal progress.

If we are to integrate the principles of sustainability into usage of the ES concept, we must accept that there are limits to the extractive pressures we can place on natural systems. This requires confronting one of the most engrained dynamics of contemporary capitalist societies.

Linking the ES concept to the principles of sustainability is therefore much easier to achieve conceptually than it is in practice. However, based on the findings from this thesis I offer the below suggestions for how such a linkage may be achieve:

- Setting of absolute limits on the aggregate level of extraction of vital forms of natural capital. Such limits should be economy wide and where possible account for effect of economic consumption across international supply chains. This would overcome the 'lack of national indictor' barrier identified in Chapter 4.
- Integration of the precautionary approach as foundational principles of all policy making to ensure that tipping points are not reached beyond which ecosystems or ecosystem features are not irrevocably altered or lost – acknowledging the uncertainty of our knowledge about complex socio-ecological systems.
- Encouraging and supporting the development of new, participatory institutions that give a wider group of stakeholder's powers to determine the course of policy and decisions.
- Using the ES concept to demonstrate the externalities caused by harmful economic practices, and use such arguments as part of movements and campaigns to drive political change.

Firmly implementing these steps would imply a radical transformation of economic practices. They are therefore not going to occur without significant political effort towards which the ES community can and should contribute. They also imply a wider transformation of our political and economic system, the specifics of which are well beyond the scope of this thesis.

7.3 FUTURE DIRECTIONS OF RESEARCH

There is a clear desire from within and out with the ES community for the concept to assist in moving society away from our current unsustainable path. This thesis has demonstrated that how the ES concept is used and integrated into governance institutions is contextually dependant. And there is no a priori reason to believe this

will be done in a manner consistent with the principles of sustainability. To inform, and contribute to, efforts to ensure the ES concept is used in a way that promotes a sustainability transition, I believe the findings and ideas of this thesis could be expanded upon in the following ways.

7.3.1 Further case studies adopting the lens of institutional change

Though there are a growing number of studies of the integration of the ES concept into governance institutions, these are typically relatively narrow in that they just focus on one institutional setting. Moving towards an understanding of institutions as overlapping policy mixes will help with the process of understanding the impact the concept has on real world decision making. Building up a body of in-depth case study research that takes such an approach would assist with the identification of barriers and drivers to adoption, and the necessary conditions for the employment of the ES concept in a manner consistent with the principles of sustainability.

Such a research agenda would benefit from more direct engagement with political scientists. The process of institutional change and formation, and the implied power dynamics of these processes, are a central but under explored aspect of ES governance. Engagement with political science would prove valuable in developing ES researchers understanding of these issues and may generate insights into how the ES concept can be leveraged to produce sustainable genuine change.

7.3.2 The role of policy entrepreneurs

One under explored finding from my work in Scottish inshore governance in chapter 4 was the role specific individuals played in attempting to integrate the ES concept. These include individuals within Marine Scotland developing personal projects to review the National Marine Plan against the ES concept, and planners in the Firth of Clyde who sought to integrate the ES concept into their work following a workshop they attended.

Though not central to my analysis, the role of these individuals sits at the background of much of my narrative in chapter 4. I believe future research on the integration of the ES concept into governance institutions would benefit with direct engagement with the phenomenon of what we might call ‘policy entrepreneurs’.

Such a research agenda could pick up questions around the embedding of sustainability principles and the underlying power dynamics of the allocation of environmental benefits. Who such entrepreneurs are, their worldview, societal

position, and motivations may be a substantial factor in the types of institutional reforms that are actualised through a consideration of ES.

7.3.3 Value incommensurability and institutional design

The latter part of this thesis moved toward consideration of plural value types and deliberative valuation approaches. Whilst we demonstrated one method of generating a policy relevant deliberative valuation, there remain a number of questions over how best to integrate insights from recent advances in value theory into how decisions are made.

One pressing question is, 'if and how we should compare, and aggregate monetary valuations arrived at through different means'. It is not clear that valuations derived through methods based on different theoretical understandings of value, can or should be directly compared. Additional research that explores how we should conceive of valuations arrived at through different means, what these do or don't tell us, and how they are best integrated into decision making processes is a vital next step in research on plural values. These are questions that have been raised before– but to date have not received sufficient research attention (Kenter et al., 2016d).

The wider question regards the issue of institutional design. The issues of aggregation and comparison mentioned above are most problematic if valuation is seen as an extractive process. By extractive I mean a process whereby valuations produce information that is then taken away by policy makers for the purpose of a top-down decision making. Valuations arrived at through deliberation, as part of a participatory approach to governance, may not need to be aggregated at a higher level. Indeed, it may not be necessary to use a monetary indicator at all. The need to consider closely contextual and potentially incommensurable values may itself provide additional argumentation for more devolved decision making. Increased devolution and political agency could in turn assist with overcoming the political barriers to a sustainability transition. Yet clearly not all decisions can or should be devolved to the lowest level, at least in part as actions taken at the local level will likely not just affect those living in the area. Though we should consider institutional design, the issue of value indicator aggregation will likely raise its head regardless of the precise institutional set up.

The ultimate questions here is, ‘how can we design institutions that allow us to make effective decisions reflective of the plurality of ways people value the environment’. Addressing this question could provide a fruitful area for future research.

7.3.4 Power analysis and movements building

Finally, I contend in this thesis that if the concept of ES is to fundamentally change our economic trajectory, it must become embedded into institutions in such a way that respects the principle of sustainability. Doing so in a just way, that contributes equally to the wellbeing of all stakeholders, requires the consideration of plural value types. Yet such a process of institutional redesign is ultimately a question of political power. The power to shape decisions and institutions is what will determine outcomes. In as much as the ES’s can contribute towards fundamental institutional redesign, it must be embedded within and seek to contribute towards wider programmes of political change.

Political power generally is under studied and undertheorized in the ES literature. ES research too often tends towards a technocratic outlook on environmental governance. The implicit theory of change within much ES research is that if the right information can be generated, more sustainable decisions will follow – years of environmental research against a backdrop of worsening ecological crisis show this is not the case. If we seek to truly contribute towards a sustainable transition, ES researchers and practitioners should seek to link their efforts and their findings to existing and growing movements demanding fundamental change to how our economy is structured. An increasingly number of environmental researchers are indeed engaging in political activism, particularly within the climate community. This is trend that should be encouraged to continue.

7.4 CONCLUDING REMARKS

Ultimately this thesis vindicates the ES concept from its harshest critics. The ES concept is not a trap door to commodification. Well applied, it can be a tool for bringing together diverse stakeholders to improve understanding and insight into the environmental challenges we face. Those engaged with the concept most closely clearly see this potential and are working to ensure what I call the pluralistic potentiality of the concept is realised. But success in this regard is not guaranteed, and more attention needs to be paid to the politics of the process of institutionalisation. As we come to understand this process better - the mechanisms

of lock in, the power of entrenched interests and the hegemony of the religion of continued economic growth - the limits of the ES concept are likely to become clearer. As much as the critics have not been vindicated, it is clear that the ES concept is far from a silver bullet. Institutional change never happens without political pressure, and significant institutional change is what is required. Embedding the ES concept as part of a process of building and invigorating democratic institutions is likely part of this work, but on its own is unlikely to be enough.

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APPENDIX 1

Full survey circulated among 350 early registrants to the European Ecosystem Services Conference 2016.

Q1. What would you like to talk about? *(Multiple-choice, single choice, mandatory)* A) Values B) Goals C) Myths D) Grumbles
Purpose (Values In the original survey)
What do you think is at the heart of the Ecosystem services framework? […] Please indicate how closely each of the following statements resembles your own thinking: P1) The ecosystem services concept provides a utilitarian framing of ecosystem functions as services in order to increase public interest in conservation. *(5-point Likert scale)* P2) The concept of ecosystem services denotes a generic idea or metaphor to increase awareness of how human well-being in many ways depends on natural systems. *(5-point Likert scale)* P3) Using an economic approach to environmental issues can help decision-makers to determine the best use of scarce ecological resources at all levels. *(5-point Likert scale)* P4) Now that you've gone through the literature statements, can you put down in your own words what you think is at the heart of the ecosystem services framework? *(Open-ended)*
P5) What, to your mind, would be the worst misuse of the ecosystem services framework? (Open-ended)
P6) Beyond basic research ethics and good practice, what values and principles or ideas should guide the practical applications of the ecosystem services framework? *(Open-ended)*
Visions (Goals in the original survey)
V1) In 20 years time, what role should the ecosystem services framework have in society? *(Multiple-choice, tick all that apply)* A) All policy is centred on the ecosystem services framework, from local to international agreements B) It is a household term, something everyone is familiar with and needs little explanation C) It is considered the paradigm shift that turned environmental protection into a core priority D) It's around but remains quite a technical term, confined to academia and high-level policy E) Everyone has finally come to their senses and moved on to a more useful framework F) Other (please describe below)
V2) What are the main challenges for the widespread use of the ecosystem services framework *(Open-ended)*
V3) What do you think are key steps to undertake in the future development of the ecosystem services framework? *(Open-ended)*
Myths
M1) Can you describe a common myth or misunderstanding you frequently encounter in your work? *(Open-ended)*
M2) Who holds these erroneous views? *(Open-ended)*
M3) And what to your mind is the source of confusion that gave rise to these myths? *(Open-ended)*
M4) How would you debunk the myth? *(Open-ended)*
M5) Have you ever encountered one of the following claims regarding ecosystem services in your work? *(Multiple-choice, tick all that apply)* A) The ecosystem services framework is based on economic terminology and therefore a capitalist concept, it's just an extension of the capitalist paradigm and all about making money B) The ecosystem services framework undermines the widely held moral-aesthetic value arguments for environmental protection and does not consider the intrinsic value of nature. C) The ecosystem services framework implicitly accepts that happiness and wellbeing can be quantified. D) Ecosystem services are purely human-centric, the framework implicitly accepts that human benefit is the only good and that we should solely protect services if they benefit humans. E) The traditional, ethical arguments for conservation have failed, so the ecosystem services framework embodies an appeal to self-interest instead.

F) The ecosystem services framework cannot support decision-making nor can it create a solution that pleases everyone and therefore has no use in informing environmental policy.
G) Other (please describe below)

Frustrations (Grumbles in the original survey)

F1) What do you find most frustrating about working with the ecosystem services framework? *(Open-ended)*

F2) What would be the best way to resolve your grumble? (*Open-ended)*
What to your mind is the biggest theoretical, moral or practical shortcoming of the ecosystem services framework? *(Open-ended)*

F3) How could that shortcoming be remedied? *(Open-ended)*

F4) Have you ever encountered one of the following frustrations? *(Multiple-choice, tick all that apply)*

A) The terminology of ecosystem services is too complicated and academic, impossible to use with non-expert audiences.
B) The ecosystem services framework is so contentious, the use of the term is best avoided when applying the framework in practice, to avoid shouting matches and people disengaging on principle.
C) In people's perceptions the ecosystem services framework is equalled with monetary valuation and selling off nature, making it a hard sell even if the study at hand doesn't look at economic aspects at all.
D) Policy makers have adopted the ecosystem services framework for their own purposes, without really paying attention to its theoretical underpinnings.
E) Ecosystem services is such a hyped buzzword, it is becoming increasingly vague and opaque, everybody uses it without much regard for what it actually entails.
F) The phrase 'ecosystem services' is used to cover a growing variety of quite distinct concepts and approaches.
G) Other

Background

A1) In the field of ecosystem services, where do you think the biggest differences of opinion lie? (*Open-ended)*

A2) What do you do? *(Multiple-choice, single option)*

A) Student/Junior Researcher
B) Academic Researcher
C) Policy maker
D) Practitioner
E) Other

A3) What is your main field of study? *(Open-ended)*

A4) How long have you been working with the ecosystem services approach? *(Open-ended)*

A5)What gender do you identify with *(Open-ended)*

A6) Schedule permitting, would you be interested in attending a follow-up workshop at the conference, to discuss some of the topics raised here in more detail? (*Yes/No)*

That was all, thank you so much for taking part and we're looking forward to meeting you in September.
Would you like to do another theme? *(Yes/No)*
[If yes, redirects to Q1]

APPENDIX 2

Coding matrix of the inductive thematic content analysis. Counts refer to the number of times each theme was mentioned by each user group. Any empty responses to open questions were removed from the analysis prior to coding.

Theme	*Summary of responses coded under theme*	Academic Researcher	Student/Junior Researcher	Practitioner	Policy maker	Other	Total
Purpose (Values)							
P4 - Can you put down in your own words what you think is at the heart of the ecosystem services framework?							
Decision-making aid	*ES as tool/support for decisionmaking & resource management*	7	1	2	1	1	**12**
Scientific approach	*ES as a scientific endeavour, expanding knowledge*	4	2	3	1	0	**10**
Awareness raising	*ES to demonstrate value of nature*	22	11	4	0	1	**38**
Holistic approach	*ES as an encompassing approach to complexity*	3	3	0	1	1	**8**
Advocacy x Science	*Responses combining science and awareness raising, focus on general public*	8	4	1	2	0	**15**
Decision x Activism	*Responses combining awareness raising and decision support, focus on policy*	4	4	0	2	1	**11**
Science x Decision	*Responses combining science and decision support, technocratic focus*	2	0	4	1	0	**7**
Other		4	1	1	0	0	**6**
P5 – What would be the worst misuse of the ecosystem services framework?							
Backfiring	*ES used to demonstrate that environmental degradation is affordable*	3	0	0	0	2	**5**
Monetary valuation	*ES solely used to put a price on nature*	28	8	4	2	1	**43**
Panacea	*ES used a cure-all applied without concern for context or applicability*	3	0	0	2	0	**5**
Poor decision making	*ES used in flawed decision-making processes*	7	2	1	1	1	**12**
Selling off nature	*ES used to commodify nature*	8	4	3	1	1	**17**
Other		6	4	4	0	0	**14**
Visions (Goals)							
V2 - What are the main challenges for the widespread use of the ecosystem services framework?							
Education & awareness	*Adressing lack of knowledge of ES framework and theoretical underpinnings*	6	2	2	2	1	**13**
Impact	*Lack of tangible impact (i.e. Halting of environmental degradation)*	0	1	0	0	2	**3**
Institutional barriers	*Historic and organisational challenges in academica and governance*	3	4	1	0	1	**9**
Methods, date & tools	*Methodological improvements needed and concerns around data gaps/quality*	11	4	5	2	1	**23**
Policy & decision making	*Lack of political will and vested interests in decision making*	4	2	2	0	2	**10**
Terminology	*Overly technical ES terminology acting as a barrier to widespread use*	9	3	0	0	0	**12**
Un-niching	*Need to move ES beyong a scientific margin into policy and public mainstream*	3	0	0	0	1	**4**
Other		1	0	0	1	0	**2**
V3 - What do you think are key steps to undertake in the future development of the ecosystem services framework?							
Better communication- General	*Responses citing better communication*	2	2	1	1	0	**6**
Better communication- Holistic emphasis	*Responses citing communication to promote holistic nature of ES framework*	0	1	0	1	0	**2**
Better communication- Stakeholder & public engagement	*Responses citing better communication with non-expert audiences*	1	1	3	0	0	**5**
Better decision-making	*Improving the decision-making process*	1	0	0	0	0	**1**
Better science- General	*Responses citing the need for better science in general (tools, methods, data, theory)*	9	2	3	3	0	**17**
Better science- Accounting	*Responses specifically citing need for better accounting for ES*	1	0	0	0	0	**1**
Better science- Include cultural values	*Responses focusing on improving inclusion cultural values in ES research/valuations*	3	2	0	1	0	**6**
Better science- Interdisciplinarity	*Responses citing need for working more interdisciplinarily in ES*	3	0	1	1	0	**5**
Science-policy	*Improvements to the science-policy interface and evidence based decisions*	15	5	1	1	0	**22**

Theme		Academic Researcher	Student/Junior Researcher	Practitioner	Policymaker	Other	Total
Myths							
M1 - Describe a common misunderstanding or myth around ecosystem services you frequently encounter in your work?							
All about the money	*ES revolves around monetary valuation of nature*	10	2	3	1	0	**16**
Other		5	1	3	0	0	**9**
M2 - Who holds these erroneous views?							
Conservationist	*Responses citing conservationists and/or environmentalists as myth believers*	4	1	0	1	0	**6**
Lay people	*Responses citing lay people as myth believers*	6	1	0	0	0	**7**
Scientists	*Responses citing other disciplines and scientists as myth believers*	8	3	1	0	0	**12**
Policymakers & practitioners	*Responses citing policymaker and/or practitioners as myth believers*	2	0	2	1	0	**5**
Other		2	0	2	0	0	**4**
M3 - What to your mind is the source of confusion that gave rise to the myth you've just described?							
Media & publications	*Responses citing certain ES publications or media in general as source of myths*	2	1	2	0	0	**5**
Terminology & concept	*Confusion seen as inherent to the language and concept of ES*	3	0	1	0	0	**4**
Woldview & ideology	*Responses citing ideological bias and vested worldviews as source of myths*	4	1	2	0	0	**7**
Other		5	1	1	1	0	**8**
M4 - How would you debunk the myth?							
Communication	*Improving communication around ES*	8	3	4	0	0	**15**
Expanding disciplinarity	*Working across disciplines and audiences*	3	0	1	0	0	**4**
Refine concept	*Improve ES framework conceptually*	1	1	0	0	0	**2**
Other		3	0	1	0	0	**4**
Frustrations (Grumbles)							
F1 - What do you find most frustrating about working with the ecosystem services framework?							
External skepticism	*Responses citing negative attitudes to ES framework*	3	0	0	0	1	**4**
Misuses	*ES framework being misapplied*	2	0	0	0	0	**2**
User friendliness	*Difficulties with terminology and high expertise needed to use ES & tools*	7	2	4	2	0	**15**
Practial implementation	*Difficulties with applying ES framework in practice*	4	0	1	2	0	**7**
Science shortcomings	*Scientific issues raised - lack of data, accounting methods, conceptual flaws*	5	4	2	1	0	**12**
Silos-Niche	*Lack of mainstreaming and inter/cross disciplinary work within ES*	4	1	0	0	0	**5**
F2 - What would be the best way to resolve your grumble?							
Best practice	*Spreading best practice guidance and knowledge sharing*	0	0	0	1	0	**1**
Educate	*Improving education around ES framework*	2	1	0	0	0	**3**
Interdisciplinarity	*Working across disciplines and audiences*	3	0	0	1	0	**4**
More research	*Issues can be addressed by further research into challenges*	1	1	0	0	0	**2**
Pick & roll	*Picking one ES framework methodology and sticking with it across all ES research*	0	0	1	0	0	**1**
Standardisation	*Standardising existing frameworks and methodologies (plural)*	3	2	3	1	0	**9**
Tailor & complement	*Tailoring ES framework to local contexts and use in conjunction with other tools*	1	0	0	0	1	**2**
F3 - What to your mind is the biggest theoretical, moral or practical shortcoming of the ecosystem services framework?							
Bias	*Problems relating to perceived ideological biases in ES framework*	0	1	0	0	0	**1**
Concept & method deficit	*Problems cited relating to the theory, concept and method of ES framework*	5	4	2	1	1	**13**
Decision-making deficit	*Issues with use of ES framework in (flawed) decision-making processes*	1	0	0	1	0	**2**
Practical implementation deficit	*Lack of practical applications of ES framework*	1	0	1	0	0	**2**
Social science deficit	*Lack of inclusion of social sciences in ES research*	4	1	1	0	0	**6**
F4 - How could that shortcoming be remedied?							
Communication	*Improved communication can address challenges*	3	0	0	1	0	**4**
Inter/ transdisciplinarity	*Improving and increasing work across disciplines and audiences*	5	0	1	0	0	**6**
More research	*Additional studies needed*	1	1	1	0	1	**4**
Public/ stakeholder engagement	*Better inclusion and outreach to general public and stakeholders*	1	1	0	2	0	**4**
Standardisation	*Standardising existing frameworks and methods*	2	3	1	0	0	**6**

APPENDIX 3

Early findings documents circulated in the delegate pack to the all participants in the European Ecosystem Services Conference 2016.

The Antwerp Declaration

The Antwerp Declaration will outline a clear message from the conference participants about ecosystem services that is relevant to the wider world. It provides a means of communicating high-level views to a range of potential audiences including decision makers, academics and practitioners. The Declaration embodies a legacy for the conference and a statement of intent from the scientific community.

Survey

To inform the discussions on the conference we sent out an online survey in July to 350 early registrants. The questionnaire gathered views from the participants on the Values, Goals, Myths and Grumbles they encounter in their work with ecosystem services. A big Thank You goes out to the **121 participants** who contributed!

Values

The Values theme asked what participants considered the core of the ecosystem services framework.

> *Ecosystems services are a wide window through which we have to realise that our survival is dependent on the planet's ecology and that we have to start to work hand in hand with it.*

At its heart, the ecosystem services framework is still viewed by most as a metaphor that **raises awareness** of the many ways human wellbeing depends on natural systems. Although frequently mentioned and occasionally criticised, economic valuation was on the whole not perceived to be inherently problematic. Its potential misuse on the other hand was a concern for many and resonated strongly with responses in the Myths theme as well.

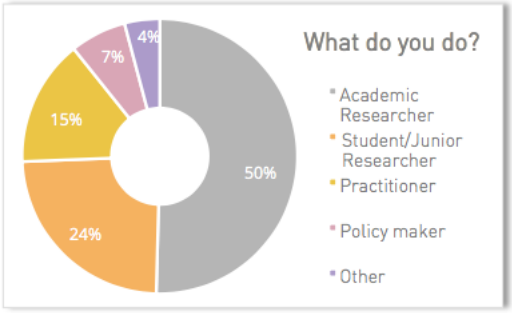
> *It's an approach that should be used very intelligently to frame environmental management challenges through a more socially relevant and integrated lens. Valuation is just one tool in the ES basket.*

However, most of our respondents come from an academic background, which begs the question from policy makers, applied researchers and practitioners:

Q – What are the practical benefits of using the ecosystem services framework on the ground? Does it indeed enable awareness raising and a more socially relevant approach to environmental management?

Goals

The ecosystem services community certainly does not lack ambition: in the Goals section the majority of respondents expressed a hope that in 20 years time the ecosystem services framework will have catalysed **a paradigm shift** that turned environmental protection into a core priority. However, despite this widespread enthusiasm and high-held hopes for the concept, a broad range of challenges was raised.



> *The language - and therefore the concept - suffers from its technocratic, utilitarian image. It has been used in this way so long that it is impossible to broaden it to embrace real-world problems (and their less tangible but essential values) fully. This is demonstrated by the still awkward and clumsy state of the cultural services debate, and the blunt refusal of many movements - and scientists - to work with it as a central concept. The time has come to face the fact that there are frontiers, and confine this concept to its safe operating space.*

We also asked what key steps are necessary for the future development of ecosystem services, and the answers were surprisingly homogenous: better communication, emphasising the holistic nature of the approach, more inclusion of socio-cultural values (and by extension social scientists), improve stakeholder engagement and strengthen the science policy nexus.

Q – Is concentrating on incorporating cultural values through transdisciplinary work and participative projects with many different stakeholders the most transformative frontier of the ecosystem services framework

Myths

We asked what myths people most frequently encountered in working with ecosystem services, and there was a very clear answer: it's all about the money. Economic valuation and commodification of nature was the most frequently raised point in this section. Interestingly enough, the reported sources of these myths and their audiences (who subscribe to the reported myths) show that it is mostly **a quarrel between scientists**. 'Other scientists' was the most cited audience to misunderstand ecosystem services, followed by conservationists, lay people, and finally policymakers & practitioners.

The remedies offered resonate with those mentioned in other themes: better communication and working more interdisciplinarily. However the direction of communication suggests an engagement gap between scientists and policymakers & practitioners, those who would arguably be one of the most important target audiences to reach. One respondent raised an interesting point in terms of the potential impact of applying the ecosystem services framework and the limits of scientific evidence:

> *[It is a myth] that describing a range of (natural) ecosystem services could counterbalance the conflicting interests of industry (and politics).*

Many respondents, especially from the policy and practitioners side called for best practice examples and effective case studies to demonstrate how ecosystem services are used in decision-making processes on the ground and to promote best practice.

Q — How can we encourage case study research of successful applications of ecosystem services that are actually being used in the decision making process?

Grumbles

A lot of the frustrations voiced in the Grumbles section had to do with **user friendliness** in various forms. On the scientific side there were complaints around the lack of standardization in the framework as well as insufficient methods, and a lack of data. Practitioners on the other hand signaled being overwhelmed by the variety of categorisations and tools available, and the background information required for their appropriate application.

Q — Instead of further adaption and refinement of ecosystem services frameworks, efforts should be focused on ensuring the existing frameworks and tools are understood by and accessible to practitioners and policymakers.

Events during the conference

Monday - Introduction

Opening address by Ben Delbaere.

Quote of the Day

From Tuesday to Thursday a statement will be up in a central location for you to discuss, leave comments and vote on. Stickers for voting have been provided: a different colour for each day and white for comments.

Tuesday - G4 Session

11:00-12:30

There will be an opportunity to discuss themes related to the Declaration in the G4 session *"Reflections on the last decade of ecosystem services research: Rights, Wrongs and the Way Forward"*. This session is organised by Alexander van Oudenhoven, Matthias Schröter and Sander Jacobs, and will take place in room K.201.

Wednesday – AD16 Workshop

12:30-16:30 (at the latest)

The main AD16 discussion event will be an interactive workshop style session, taking place over lunch and into the afternoon on Wednesday. We will ply you with food and drink, and set your brilliant minds to work over some of the puzzles thrown up by the survey results and previous discussions. Location TBC.

NOTE: This event runs parallel to the field excursions, and has limited spaces. If you would like to attend please e-mail: aster.devrieslentsch@ed.ac.uk.

Thursday – Drop-In Session

09:00-12:30

We will run a drop-in session in the morning. Pop in to discuss the Declaration progress, share your thoughts on the Quotes or take a seat and to be our armchair critic!

Friday – Official launch

Social Media - #AD16 (Twitter)

CONTACT

If you have any questions about the Antwerp Declaration, please get in touch with Aster via e-mail: aster.devrieslentsch@ed.ac.uk.

All quotes used were taken directly from the survey as illustrative examples of points raised.

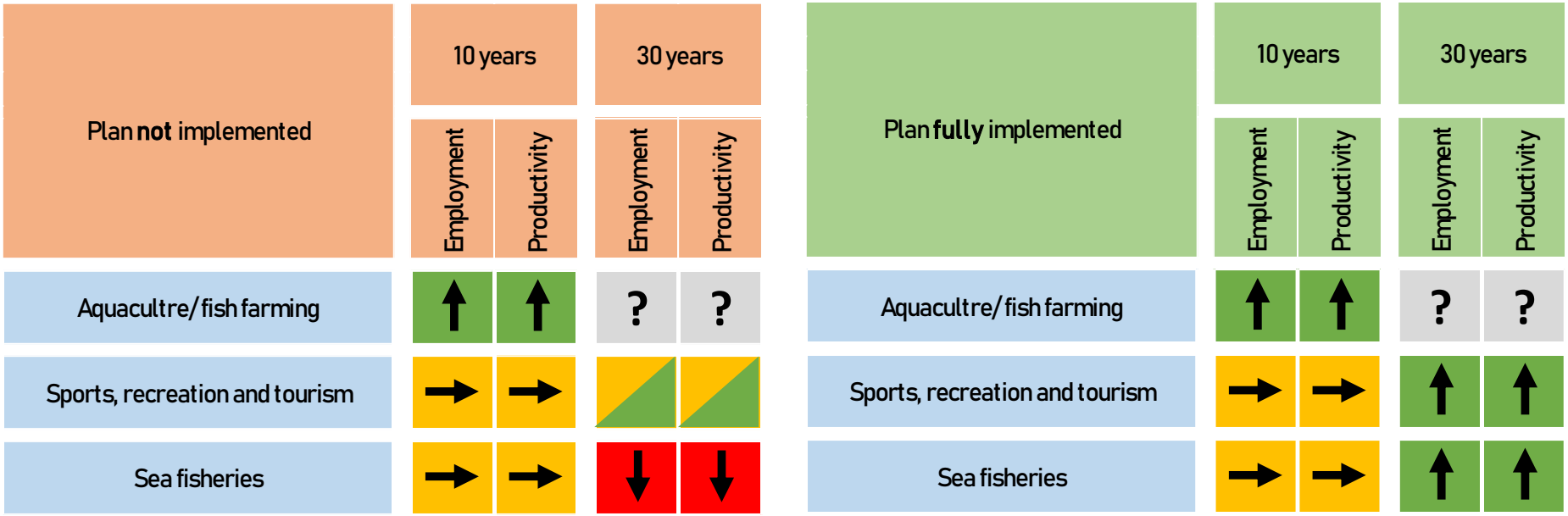
APPENDIX 4

Author	Title	Year
Scottish Government	Planning circular 1/2015: The relationship between the statutory land use planning system and marine planning and licensing	2015
Scottish Executive	Recommendations of the Advisory Group on Marine and Coastal Strategy	2007
Scottish National Heritage	Commissioned Report No. 388. Identification of Priority Marine Features in Scottish territorial waters	2012
Joint Nature Conservation Committee	JNCC Report No. 462. Identification of Priority Marine Features in Scottish offshore waters	2012
CMPP and NAFC	Shetland and Clyde Marine Plans and SEAs	NA
Scottish Environment Protect Agency	Finfish aquaculture sector plan	2018
Scottish Government	Planning Scotland's Seas. 2013 Possible Nature Conservation Marine Protected Areas Consultation Overview. Sustainability Appraisal/ Consultation analysis report	2013
Scottish Environment Protection Agency	Regulation of marine cage fish farms: Updating our approach to protecting the sea bed	2017
Aitkenhead et al.	A review of ecosystem service mapping within Scottish Government RESAS-funded research	2015
Williams et al. (SEPA)	The value of Scotland's ecosystem services and natural capital	2003
Stojanovic	Scoping the design of a regional marine planning process. A report to the MASTS Marine Planning and Governance Forum	2017
Scottish Natural Heritage	Research Report No. 1071. Feasibility study for a Marine Natural Capital Asset Index for Scotland	2019
Marine Scotland	A quality management review of Scotland's sectoral marine plan for tidal energy	2016
Marine Scotland	Scottish Inshore Fisheries Strategy	2015
Marine Scotland	Marine and Freshwater Journal archive: CORPORATES and A Quality Management Review of Scotland's Sectoral Marine Plan for Tidal Energy	NA
Aberdeen Council	Local Development Plan	
Marine Scotland	National Marine Plan Review 2018: three-year report	2018

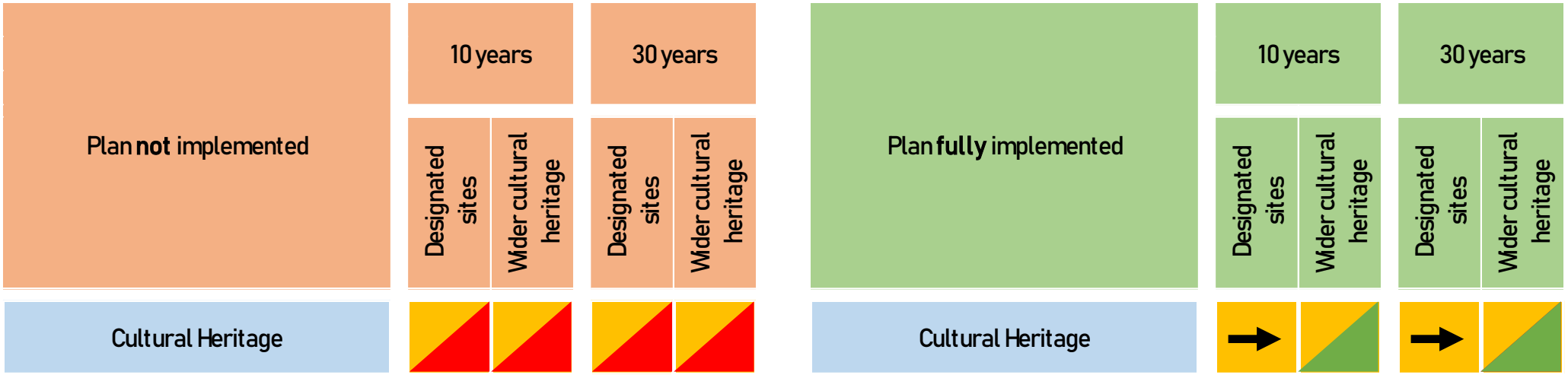
APPENDIX 5

1. Scenarios used in workshops
2. Values hand out
3. Council tax information sheet

			Plan **not** implemented		Plan **fully** implemented		
Current Status	Status	Trend	10 years	30 years	10 years	30 years	Notes
Marine fish and shellfish							Benefits if the plan can stimulate strong fisheries management measures
Seabirds and waterbirds							Long term impacts of climate change are highly uncertain
Basking sharks							This species will be most impacted by wider / international action
Other sharks							Long term benefits if protection of essential habitats are strongly enforced and plan can stimulate strong fisheries management
Whales, dolphins and porpoises							Best plan likely to do is to halt decline. The impact of climate change make longer term trends highly uncertain
Seals							With or without the plan, seals are likely to continue to recover in the short term.
Rocky seabed habitats							Climate change likely to start to have a negative impact over 30 year time frame
Soft seabed habitats							Benefits if the plan can stimulate strong fisheries management measures
Biogenic reefs							Already very damaged in the Clyde and very slow growing so will take a long time to recover. Protection in the plan will need to be strongly implemented
Climate change							Local action on climate change is important. However the plan alone is unlikey to have a significant effect in the absense of wider action on climate change
Invasive species							Very difficult to stop the spread of invasive species. At best the plan may limit the introduction new invasive species.
Marine litter							Positive effects if plan stimulates wider anti-litering measures. As litter does not break down quickly, it will take some time for positive effects to show



Notes	
Aquacultre/fish farming	Government objective to increase aquaculture output means likely expansion in the Clyde with or without the plan – although the plan will help to identify suitable sites and limit environmental impact. There is uncertainty over the 30 year time scale as local concern and increasing environmental impact may restrict further growth.
Sports, recreation and tourism	Efforts at development in these sectors are ongoing even without plan – an increase in employment and productivity is possible over 30 year time frame wihtout the plan. The plan is likely to support these efforts.
Sea fisheries	Fisheries in the Clyde are currently focused primarily on shellfish. Positive effects of plan are only likely if it is properly enforced and finfish populations recover. Uncertainties also exist due to the impact of Brexit on the sector.



Notes

There is some concern that coastal errosion caused by climate change may impact on designated sites even in a 10 year time frame. Environmental pressures are not the only issues for cultural heritage sites, with key 'paid entry' sites being heavily dependant on government support and subsidy. The plan may help to maintain these sites in their current state. Heritage sites and wider cultural heritage (e.g. food and drink, arts and crafts) are also closely connected to the tourism industry. The focus of the plan on increasing tourism is likely to have positive impact on cultural heritage, in part by increaseing revenue for key sites - but these benefits will need to be balanced with the increased environmental pressures that more tourism will also bring.

WORKSHOP MATERIAL

Values handout

Part of the workshop will be spent in plenary with everyone together, other parts will take place at break-out tables in small groups. The colour in the box below indicates which group you are in and matches the sign on the table.

Group	

Before the start of the workshop, please take a few minutes to consider the values in the list below. These are broad values relating to what is important to you and the way you live your life. Please indicate by way of a tick which you consider to be the **top five** most important values.

Values	Enter a tick next to **top five** values
Protecting the environment	
Unity with nature, fitting into nature	
A world at peace, free of conflict	
Social justice, fairness	
A world of beauty	
Responsibility	
Honesty, transparency	
Health	
Family security	
Respect for tradition	
Social order	
Sense of belonging	
Authority	
Influence	
Wealth	
A varied life, filled with challenge, novelty and change	
Enjoying life	
Freedom	

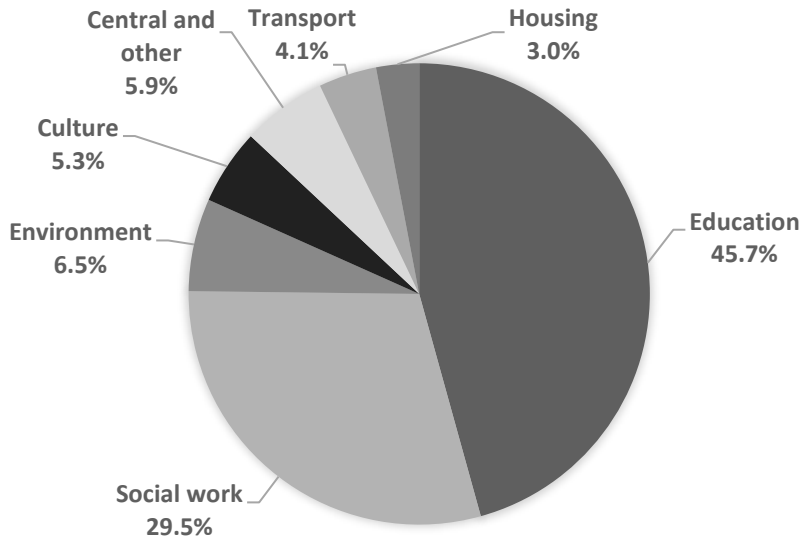
Once you have completed this sheet, please return it to a facilitator. We will return to this information later in the workshop.

WORKSHOP MATERIAL

Council tax information sheet

This sheet is provided to help you understand the cost of different services delivered by local authorities as a percentage of council tax. We have included the related annual cost for each council tax band.

This chart shows the percentage of council tax used for each major spending category



This table shows the cost of some key services (as a percentage of total expenditure) and the corresponding annual cost for some indicative tax bands. Further examples can be found on the reverse side of this sheet.

	Percentage	Council tax bands (annual cost)		
		Band A	Band D	Band G
Secondary education	17.58%	£145.70	£218.55	£428.00
Museums and galleries	0.39%	£3.25	£4.87	£9.55
Library service	0.92%	£7.64	£11.45	£22.43
Sport facilities	1.44%	£11.90	£17.84	£34.94
Social care for elderly	12.52%	£103.76	£155.63	£304.78
Road maintenance	1.32%	£10.91	£16.36	£32.04
Public transport	1.31%	£10.84	£16.26	£31.83
Waste collection and disposal	4.41%	£36.57	£54.85	£107.41
Homelessness	0.88%	£7.33	£11.00	£21.54

Note on data: Data taken from Local Government Finance statistics compiled by the Scottish Government[12]. Expenditure data from the year 2017-2018. Council tax bands from year 2019-2020 and averaged across all Scottish local authorities. Local authority expenditure is funded from a number of revenue streams - for simplicity, we have assumed council tax income is used for all services provided by local authorities and the percentage of council tax used for each service is identical to the percentage of total funding spent on the service.

[12] https://www2.gov.scot/Topics/Statistics/Browse/Local-Government-Finance

	Percentage	Council tax bands (Scottish average exc. water charges)							
		Band A	Band B	Band C	Band D	Band E	Band F	Band G	Band H
Education (total)	**46%**	**£377.71**	**£440.66**	**£503.61**	**£566.56**	**£744.40**	**£920.66**	**£1,109.52**	**£1,388.08**
Pre-primary education	3.77%	£31.26	£36.46	£41.67	£46.88	£61.60	£76.19	£91.81	£114.86
Primary education	17.91%	£148.50	£173.25	£198.00	£222.74	£292.66	£361.96	£436.21	£545.72
Secondary education	17.58%	£145.70	£169.98	£194.27	£218.55	£287.15	£355.15	£428.00	£535.45
Special education	5.18%	£42.92	£50.07	£57.22	£64.38	£84.58	£104.61	£126.07	£157.72
Community Learning	0.94%	£7.77	£9.06	£10.36	£11.65	£15.31	£18.93	£22.82	£28.54
Cultural and related services (total)	**5.27%**	**£43.72**	**£51.01**	**£58.30**	**£65.59**	**£86.17**	**£106.58**	**£128.44**	**£160.69**
Museums and galleries	0.39%	£3.25	£3.79	£4.33	£4.87	£6.40	£7.92	£9.55	£11.94
Other cultural and heritage services	0.52%	£4.29	£5.00	£5.72	£6.43	£8.45	£10.45	£12.59	£15.76
Library service	0.92%	£7.64	£8.91	£10.18	£11.45	£15.05	£18.61	£22.43	£28.06
Promotional Events	0.10%	£0.86	£1.00	£1.15	£1.29	£1.70	£2.10	£2.53	£3.16
Other Tourism	0.10%	£0.86	£1.00	£1.15	£1.29	£1.70	£2.10	£2.53	£3.16
Countryside recreation & management	0.21%	£1.73	£2.02	£2.31	£2.59	£3.41	£4.21	£5.08	£6.35
Sport facilities	1.44%	£11.90	£13.88	£15.86	£17.84	£23.44	£29.00	£34.94	£43.72
Community parks and open spaces	1.09%	£9.02	£10.53	£12.03	£13.54	£17.79	£22.00	£26.51	£33.16
Social work (total)	**29.41%**	**£243.82**	**£284.46**	**£325.10**	**£365.74**	**£480.54**	**£594.32**	**£716.23**	**£896.05**
Service Strategy	0.08%	£0.65	£0.76	£0.87	£0.98	£1.29	£1.59	£1.92	£2.40
Children's Panel	0.01%	£0.04	£0.05	£0.06	£0.07	£0.09	£0.11	£0.13	£0.16
Children and families	8.63%	£71.53	£83.45	£95.37	£107.29	£140.97	£174.35	£210.12	£262.87
Older persons	12.52%	£103.76	£121.05	£138.34	£155.63	£204.48	£252.90	£304.78	£381.30
Adults with additional needs	8.11%	£67.21	£78.42	£89.62	£100.82	£132.47	£163.83	£197.44	£247.01
Criminal justice social work services	0.08%	£0.63	£0.73	£0.84	£0.94	£1.24	£1.54	£1.85	£2.31
Roads and transport (total)	**4.06%**	**£33.64**	**£39.25**	**£44.86**	**£50.47**	**£66.31**	**£82.01**	**£98.83**	**£123.65**
Road construction	0.03%	£0.26	£0.31	£0.35	£0.39	£0.52	£0.64	£0.77	£0.96
Winter maintenance	0.77%	£6.35	£7.41	£8.47	£9.53	£12.52	£15.49	£18.66	£23.35
Maintenance & repairs	1.32%	£10.91	£12.72	£14.54	£16.36	£21.49	£26.58	£32.04	£40.08
Road lighting	0.60%	£4.95	£5.77	£6.59	£7.42	£9.75	£12.06	£14.53	£18.18
School crossing patrols	0.12%	£1.02	£1.20	£1.37	£1.54	£2.02	£2.50	£3.01	£3.76
Other network and traffic management	0.29%	£2.40	£2.80	£3.20	£3.60	£4.73	£5.85	£7.05	£8.81
Parking	-0.39%	-£3.22	-£3.75	-£4.29	-£4.82	-£6.34	-£7.84	-£9.45	-£11.82
Non-LA Public Transport subsidies	1.09%	£9.00	£10.50	£12.00	£13.50	£17.74	£21.94	£26.45	£33.09
Local authority Transport	0.22%	£1.83	£2.14	£2.45	£2.75	£3.61	£4.47	£5.39	£6.74
Road Bridges	0.02%	£0.13	£0.16	£0.18	£0.20	£0.26	£0.33	£0.39	£0.49
Environmental services (total)	**6.48%**	**£53.68**	**£62.62**	**£71.57**	**£80.52**	**£105.79**	**£130.84**	**£157.68**	**£197.26**
Cemetery and mortuary services	-0.03%	-£0.24	-£0.28	-£0.32	-£0.36	-£0.47	-£0.59	-£0.71	-£0.88
Coast protection	0.01%	£0.08	£0.09	£0.10	£0.12	£0.15	£0.19	£0.23	£0.29
Flood defence and land drainage	0.08%	£0.64	£0.74	£0.85	£0.96	£1.26	£1.56	£1.88	£2.35
Environmental Health	0.72%	£6.00	£6.99	£7.99	£8.99	£11.82	£14.61	£17.61	£22.03
Trading Standards	0.30%	£2.47	£2.88	£3.30	£3.71	£4.87	£6.03	£7.26	£9.09
Waste Collection and disposal	4.41%	£36.57	£42.66	£48.75	£54.85	£72.07	£89.13	£107.41	£134.38
Planning & Development (total)	**2.00%**	**£16.60**	**£19.37**	**£22.14**	**£24.91**	**£32.72**	**£40.47**	**£48.77**	**£61.02**
Planning: Building control	-0.02%	-£0.17	-£0.20	-£0.23	-£0.26	-£0.34	-£0.42	-£0.50	-£0.63
Planning: Development control	0.13%	£1.08	£1.27	£1.45	£1.63	£2.14	£2.64	£3.19	£3.99
Planning: Policy	0.28%	£2.33	£2.72	£3.11	£3.50	£4.60	£5.69	£6.86	£8.58
Planning: Environmental initiatives	0.08%	£0.67	£0.78	£0.89	£1.01	£1.32	£1.64	£1.97	£2.47
Economic development	1.53%	£12.68	£14.80	£16.91	£19.03	£25.00	£30.92	£37.26	£46.62
Non-HRA Housing (total)	**3.00%**	**£24.85**	**£28.99**	**£33.13**	**£37.27**	**£48.97**	**£60.57**	**£72.99**	**£91.32**
Private sector housing renewal	0.21%	£1.78	£2.08	£2.37	£2.67	£3.51	£4.34	£5.23	£6.55
Housing benefits: Rent allowances	0.42%	£3.46	£4.04	£4.61	£5.19	£6.82	£8.44	£10.17	£12.72
Homelessness	0.88%	£7.33	£8.56	£9.78	£11.00	£14.45	£17.88	£21.54	£26.95
Welfare Services	0.11%	£0.88	£1.02	£1.17	£1.32	£1.73	£2.14	£2.58	£3.22
Administration of housing advances	0.00%	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
Housing Support Services	0.97%	£8.03	£9.37	£10.71	£12.05	£15.83	£19.58	£23.59	£29.52